ACS 600

User's Manual

ACA 635 IGBT Supply Sections (ISU) 260 to 4728 kVA

This manual includes
- Safety
- Commissioning of the Supply Section with ISU
- Functional Description
- Parameters
- Fault Tracing
- Technical Data

ACS 600 MultiDrive Manuals (Air-cooled Units, English Originals)

GENERAL MANUALS

***Safety and Product Information** EN 63982229
- Complete general Safety Instructions
- Technical data for DSU and TSU supplies and Drive Sections: ratings, power losses, dimensions, weights, fuses etc.

***System Description** EN 63700151
- General description of ASC 600 MultiDrive

***Hardware Manual** EN 63700118
- General Safety Instructions
- Hardware description of the Drive Section
- Cable selection
- ACS 600 MultiDrive mechanical and electrical installation
- Hardware commissioning of the Drive Section
- Preventive maintenance of ACS 600 MultiDrive

ACS 600 MultiDrive Control Electronics LED Indicators EN 64289721
- LED descriptions

****Modules Product Catalogue** EN 64104268
- Supply Unit components
- Drive Unit components
- Dynamic Braking Units
- Drive*Ware* information
- Dimensional drawings
- Single line diagrams
- Auxiliary power consumption
- Master component tables

****Modules Installation Manual** EN 64119010
- Cabinet assembly
- Wiring

****Grounding and Cabling of the Drive System** EN 61201998
- Grounding and cabling principles of a variable speed drive system

****EMC Compliant Installation and Configuration for a Power Drive System** EN 61348280

* Included with cabinet-assembled systems only
** Included in Modules deliveries only

SUPPLY SECTION MANUALS (depending on the supply type one of these manuals is included in the delivery)

Diode Supply Sections User's Manual (DSU) EN 61451544
- DSU specific Safety Instructions
- DSU hardware and software descriptions
- DSU commissioning
- Earth fault protection options

Thyristor Supply Sections User's Manual (TSU) EN 64170597
- TSU operation basics
- TSU firmware description
- TSU program parameters
- TSU commissioning

IGBT Supply Sections User's Manual (ISU) EN 64013700
- ISU specific Safety Instructions
- Main components of ISU
- ISU ratings
- ISU power losses
- ISU dimensions and weights
- ISU fuses
- ISU program parameters
- Earth fault protection options

FIRMWARE MANUALS FOR DRIVE APPLICATION PROGRAMS (appropriate manual is included in the delivery)

System EN 63700177
- Commissioning of the System Application Program
- Control Panel use
- Software description
- Parameters of the System Application Program
- Fault tracing
- Terms

Application Program Template EN 63700185
- Commissioning of the Drive Section
- Control Panel use
- Software description
- Parameters
- Fault tracing
- Terms

Standard EN 61201441
- Control Panel use
- Standard application macros with external control connection diagrams
- Parameters of the Standard Application Program
- Fault tracing
- Fieldbus control

Note: a separate Start-up Guide is attached

Crane Drive EN 3BSE 011179
- Commissioning of the Crane Drive Application Program
- Control Panel use
- Crane program description
- Parameters of the Crane Drive Application Program
- Fault tracing

CONTROL SECTION MANUALS (delivered with optional Control Section)

Advant Controller 80 User's Manual EN 64116487
- AC 80 hardware and connections
- AC 80 software
- Programming
- Diagnostics

Advant Controller 80 Reference Manual PC Elements EN 64021737
- Description of PC and DB elements

Advant Controller 80 Reference Manual TC Elements EN 64331868
- Description of TC elements

BRAKING SECTION MANUAL (delivered with optional Braking Section)

ACA 621/622 Braking Sections User's Manual EN 64243811
- Installation, Start-up, Fault tracing,Technical data
- Dimensional drawings

MANUALS FOR OPTIONAL EQUIPMENT (delivered with optional equipment)

Fieldbus Adapters, I/O Extension Modules, Braking Choppers etc.
- Installation
- Programming
- Fault tracing
- Technical data

ACA 635 IGBT Supply Sections 260 to 4728 kVA

User's Manual

This manual concerns the ACS 600 MultiDrive supply sections (ACA 635) equipped with an IGBT Supply Unit and the ACS/ACC 617 drives.

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EN
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SUPERSEDES: 21.10.1999

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Safety Instructions

Overview

The complete safety instructions for the ACA 6xx in *Safety and Product Information* (EN code: 63982229) and for the ACS/ACC 617 in *Hardware Manual* (EN code: 61329005) must be followed when installing, operating and servicing the drives. Study the complete safety instructions carefully.

Installation and Maintenance Safety

These safety instructions are intended for all who work on the ACA 6xx or the ACS/ACC 617. Ignoring these instructions can cause physical injury or death.

WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians.

Any installation work must be done with power off, and power is not to be reconnected unless the installation work is complete. Dangerous residual voltages remain in the capacitors when the disconnecting device is opened. Wait for 5 minutes after switching off the supply before starting work. Always ensure by measuring that the voltage between the terminals UDC+ and UDC- and the frame is close to 0 V and that the supply has been switched off before performing any work on the equipment or making main circuit connections.

If the main circuit of the inverter unit is live, the motor terminals are also live even if the motor is not running!

Open switch fuses of all parallel connected inverters before doing installation or maintenance work on any of them. These switch fuses are not included in the ACS/ACC 617.

Check the cable connections at the shipping split joints before switching on the supply voltage.

If the auxiliary voltage circuit of the drive is powered from an external power supply, opening the disconnecting device does not remove all voltages. Control voltages of 115/230 VAC may be present in the digital inputs or outputs even though the inverter unit is not powered. Before starting work, check which circuits remain live after opening of the disconnecting device by referring to the circuit diagrams for your particular delivery. Ensure by measuring that the part of the cabinet you are working on is not live.

The control boards of the converter unit may be at the main circuit potential. Dangerous voltages may be present between the control boards and the frame of the converter unit, when the main circuit voltage is on. It is critical that the measuring instruments, such as an oscilloscope, are used with caution and safety as a high priority. The fault tracing instructions give special mention of cases in which measurements may be performed on the control boards, also indicating the measuring method to be used.

Live parts on the inside of doors are protected against direct contact. Special safety attention shall be paid when handling shrouds made of sheet metal.

Do not make any voltage withstand tests on any part of the unit while the unit is connected. Disconnect motor cables before making any measurements on motors or motor cables.

WARNING! Close switch fuses of all parallel connected inverters before starting the drive.

Do not open the drive section switch fuses when the inverter is running.

Do not use Prevention of Unexpected Start for stopping the drive when the inverter is running. Give a Stop command instead.

CAUTION! Fans may continue to rotate for a while after the disconnection of the electrical supply.

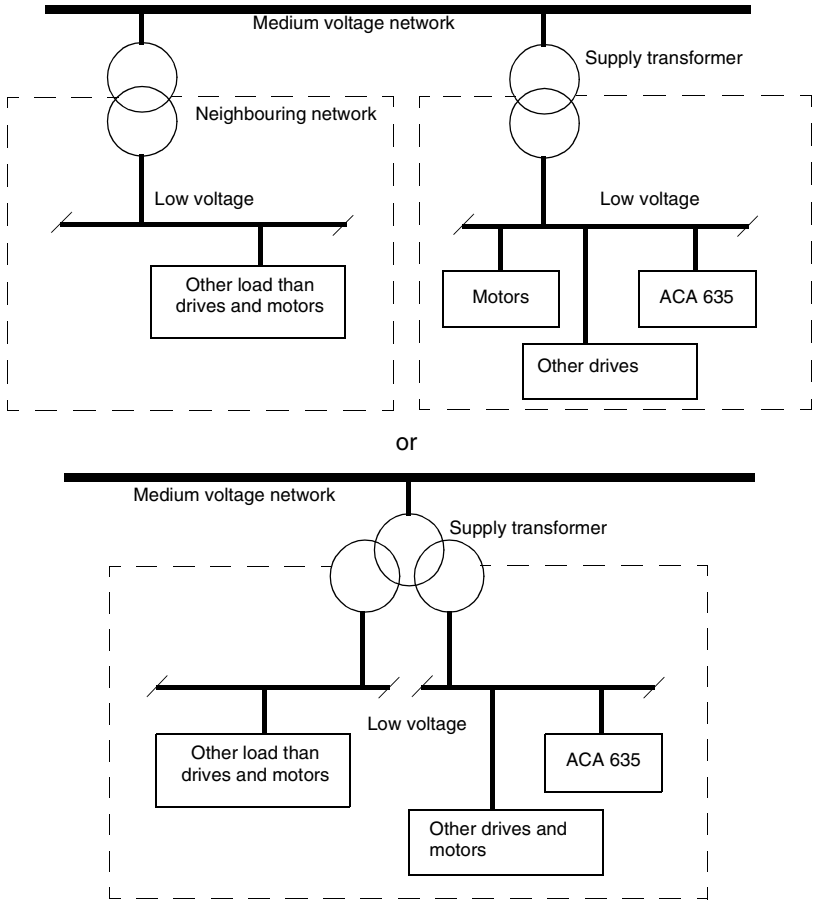
CAUTION! Some parts like heatsinks of power semiconductors and toroidal cores on motor cables inside the cabinet remain hot for a while after the disconnection of the electrical supply.

Automatic Resets

WARNING! If an external source for start command is selected and it is ON, the ACA 635 will start immediately after fault reset.

Dedicated Transformer

WARNING! The ACA 635 must be supplied with a transformer dedicated to drives and motors or equipment of equal or higher power, or with a transformer equipped with two secondary windings, one of which is dedicated to drives and motors. Resonances might occur if there is capacitive load (e.g. lighting, PC, PLC, small power factor compensation capacitors) in the same network with the ACA 635. The resonance current might damage some unit in the network.



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Chapter 1 – Introduction

About this Manual

The ACA 635 supply section includes an Auxiliary Control Unit, an Incoming Unit, a Filter Unit and an IGBT Supply Unit (ISU). This manual covers:

- Safety Instructions
- Use of the ISU
- Descriptions for system, hardware and software (version Ixxx 5060 and later). The descriptions provide the possibility to operate and optimize the unit for a particular system.
- The commissioning of the supply section
- Parameters of the IGBT supply unit control program
- Fault tracing
- Technical data giving information concerning the ratings, fuses, cooling requirements, power losses etc.

Study this manual carefully before installing, commissioning, operating or servicing the supply section equipped with an IGBT supply unit. We expect that you have a basic knowledge of physical and electrical fundamentals, electrical wiring practices, electrical components and electrical schematic symbols.

Note: **The parameters of the ISU listed in this manual need not be set in a normal start-up procedure or in normal use.** However, the ISU parameters can be viewed and changed with the Control Panel.

ISU-related Information in Other Manuals

Items concerning the ACA 635 not described in this manual are listed below with a reference to the manual where they are described. For EN codes of the manuals refer to the inside of the front cover of this manual.

<table>
<tr><th>Task</th><th>Described in</th><th>Instruction/Information</th></tr>
<tr><td>Mechanical and Electrical Installation of ISU</td><td>ACS 600 MultiDrive Hardware Manual (EN code: 63700118) or ACx 6x7 Hardware Manual (EN code: 61329005)</td><td rowspan="2">Perform the installation according to the instructions. See the required general data from the ACS 600 MultiDrive Safety and Product Information guide (or Appendix A in ACx 6x7 Hardware Manual, EN code 61329005) and the ISU specific data from Appendix A – Technical Data in this manual.</td></tr>
<tr><td>Preventive Maintenance</td><td>as above</td></tr>
<tr><td>Installation of Optional Modules and DriveWindow</td><td>as above</td><td>Install any optional modules and DriveWindow according to the instructions given in Chapter 3 – Electrical Installation.</td></tr>
<tr><td>Associating ISU with DriveWindow</td><td>DriveWindow Start-up Guide EN code 36458585</td><td>When associating DriveWindow 1.3 and 1.4 with the ISU proceed as follows:
<table>
<tr><th>System Configuration Messages</th><th>What to do</th></tr>
<tr><td>Error: Encountered target ‘ISU600-xxxx-x’ is unknown. Do you wish to associate it?</td><td>Click OK.</td></tr>
<tr><td>Associate ‘ISU600-xxxx-x’ With</td><td>Choose ACS600 MultiDrive from the list.</td></tr>
<tr><td>Do you wish association ‘ISU600-xxxx-x’ = ACS600 MultiDrive be permanent?</td><td>Click Yes.</td></tr>
</table></td></tr>
<tr><td>User Interface</td><td>The use of the Control Panel is described in detail in ACS 600 Firmware Manual (for System, Standard or Crane Drive Application Program).</td><td>The user interface of the IGBT Supply Unit is a CDP 312 Control Panel or PC, which is equipped with a DDCC board and DriveWindow.</td></tr>
</table>

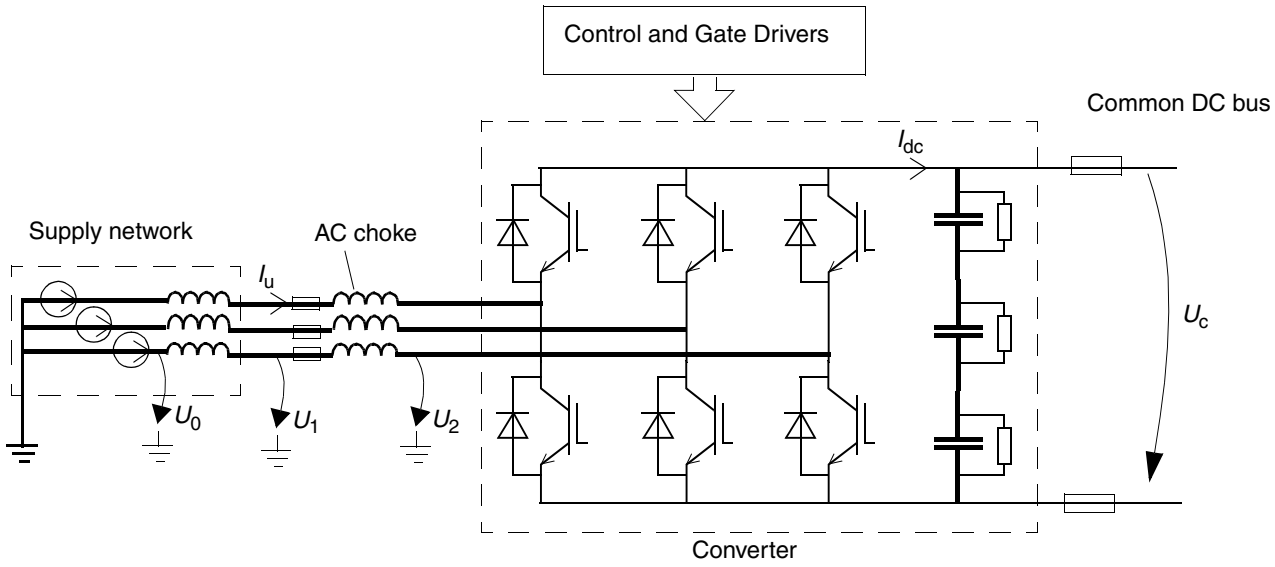
Chapter 2 – Operation Basics

Operation of ISU

The ISU is a four-quadrant switching-mode converter. The a.c. current of the ISU is nearly sinusoidal at a unity power factor. In addition, the power flow through the converter is reversible. As a default, the ISU controls the DC link voltage to the peak value of the line-to-line voltage. The DC voltage reference can be set also higher by a parameter.

Main Circuit Diagram

A diagram of the main circuit of the IGBT supply is shown below.



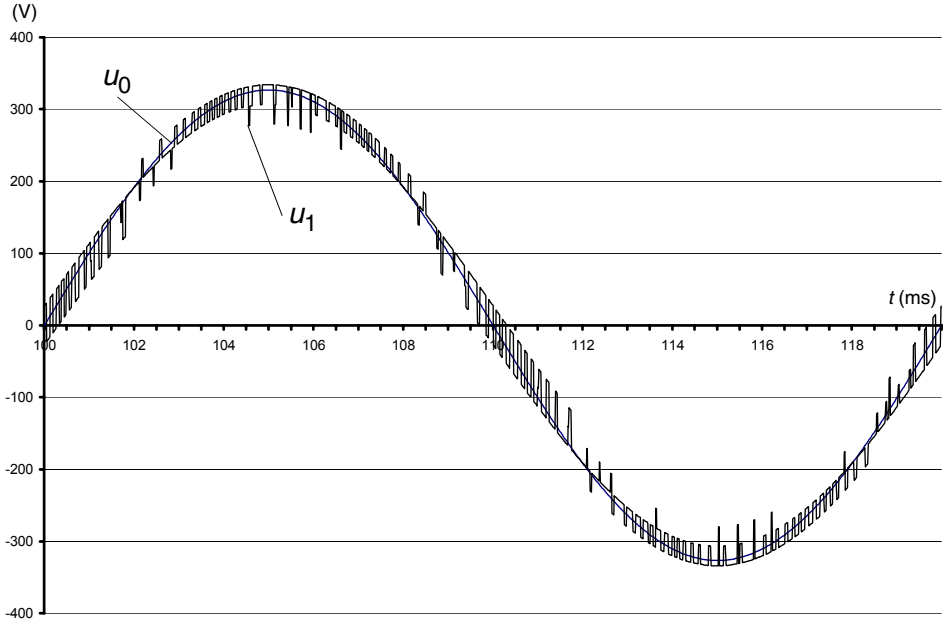
Control

The control and modulation is based on the Direct Torque Control (DTC) method typically used in ACS 600 motor control. Two line currents and DC link voltage are measured and used for the control. The control boards are similar to the boards of the inverter.

Voltage Waveform

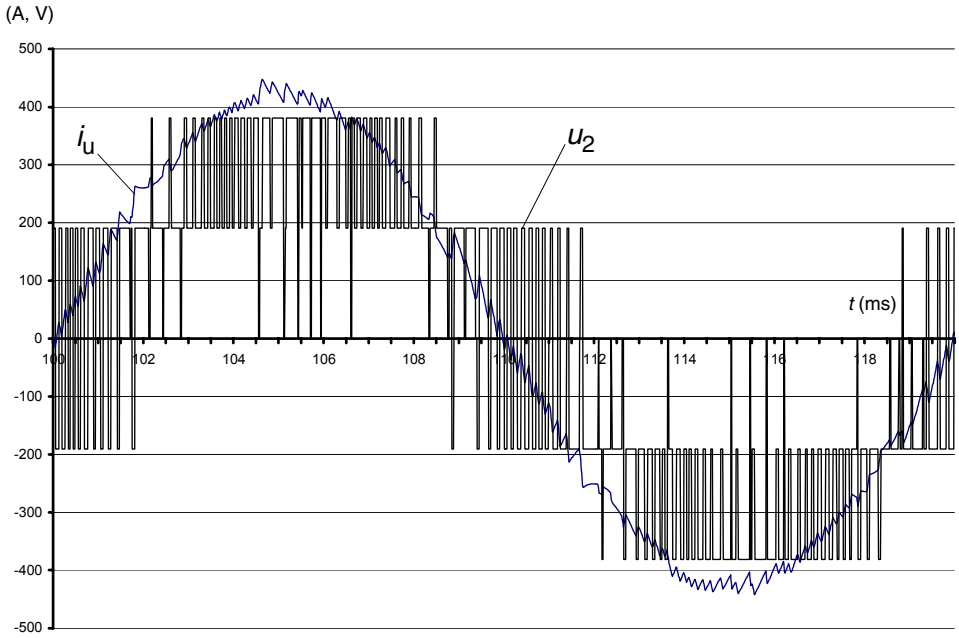
The high frequency switching and high du/dt slightly distorts the voltage waveform at the input of the converter. The depth of the voltage notches depends on the ratio of network inductance to total line inductance (network + AC choke inductance).

Diagram The waveforms of u_0 and u_1 shown below. The measuring points are given in the main circuit diagram above.



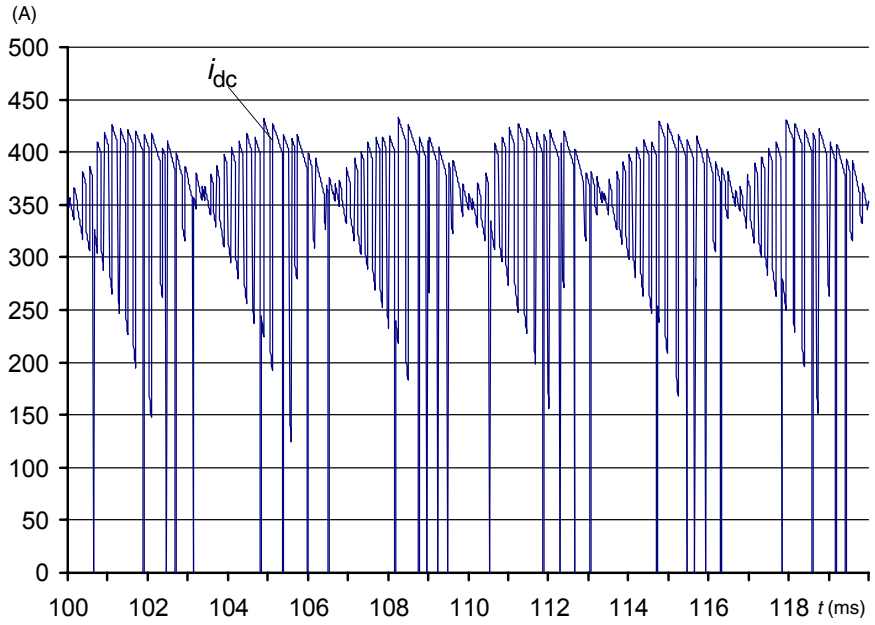
Current Waveform The line current has a sinusoidal waveform, whereas the d.c. current consists of a d.c. component and a high switching frequency component.

Line Current A typical line current (i_u) waveform is shown below. u_2 denotes converter input voltage.



DC Current

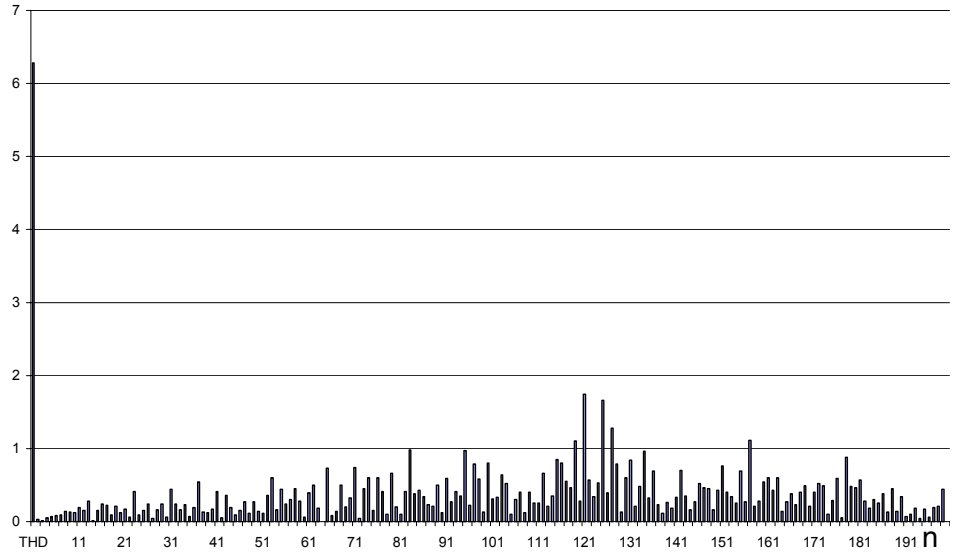
A typical DC current (i_{dc}) waveform is shown below.



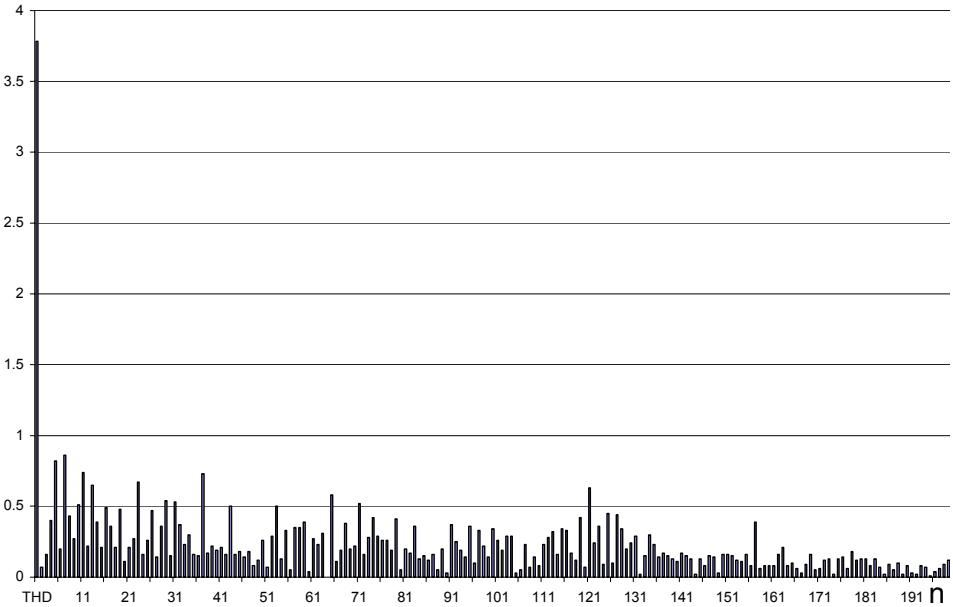
Harmonics

IGBT supply unit does not generate characteristic current/voltage overtones the way a traditional 6- or 12-pulse bridge does, because of the sinusoidal waveform of the line current. The typical spectrum of the line current and line-to-line voltage harmonics is quite wide, but there are no high individual components. The Total Harmonic Distortion (THD) in voltage depends highly on the Short Circuit Ratio in the Point of Common Coupling (PCC), refer to *Appendix A – Technical Data*.

Voltage Harmonics A typical spectrum of the voltage harmonics at the output of the transformer is shown below. Each harmonic is presented as a percentage of the fundamental voltage. n denotes the order of the harmonic.



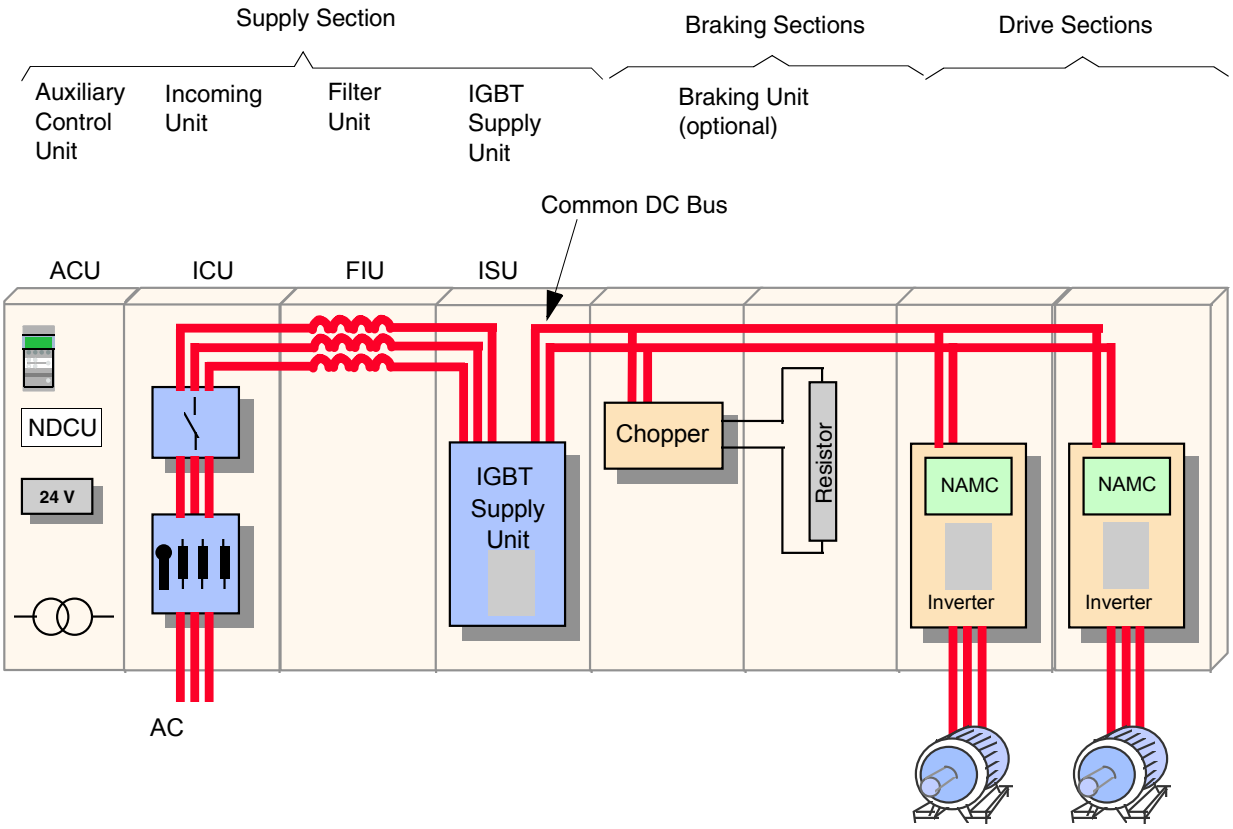
Line Current Harmonics A typical spectrum of the line current harmonics is shown below. Each harmonic is presented as a percentage of the fundamental current. n denotes the order of the harmonic.



Chapter 3 – Hardware Description

Main Components of ACS 600 MultiDrive with ISU

The main components of an ACS 600 MultiDrive frequency converter (AC Drive) equipped with an IGBT supply unit are shown below. Two drive sections are drawn in the diagram, in reality the number of them varies. This chapter describes the supply section.



Supply Section

The supply section consists of the units listed below:

- Auxiliary Control Unit (ACU)
- Incoming Unit (ICU)
- Filter Unit (FIU)
- IGBT Supply Unit (ISU).

Auxiliary Control Unit The following components are located in the Auxiliary Control Unit:

- Drive Control Unit (NDCU), which includes an Application and Motor Controller (NAMC) Board and a standard I/O (NIOC) Board
- Optical Branching Unit (NPBU) with parallel connected IGBT Supply Units (frames 2 or 4 times R11i and R12i). NPBU is connected between NAMC and NINT boards (inside the converter module).
- Control voltage supply (fuses and transformer)
- On/off switch on the cabinet door and relays
- Optional CDP 312 Control Panel and NLMD-01 Monitoring Display
- Optional voltage and current meters
- Control wiring and relays
- Auxiliary voltage filter for sensitive equipment (I_N = 17 A, 230/115 V)
- Optional emergency and earth fault protection components
- Other options (fieldbus adapter modules, man/machine interfaces etc.)

Incoming Unit The following components are located in the Incoming Unit:

- Terminals for the input power (a.c. supply) connection
- **Frames R8i to R10i:** switch fuse (including AC fuses) and main contactor. **Frames R11i and above:** air circuit breaker.
- Optional earthing switch
- Charging fuses and contactor
- Current transformer of optional ammeters

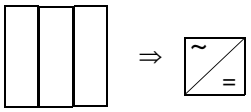
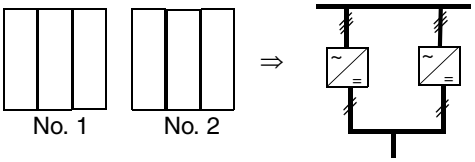
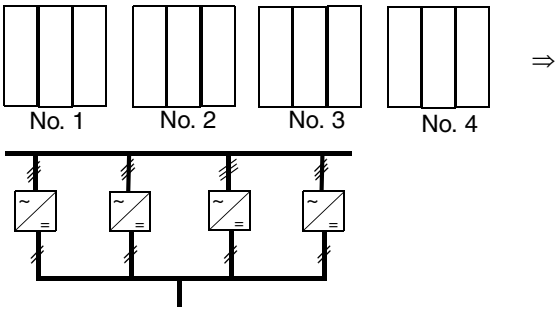
Filter Unit The following components are located in the Filter Unit:

- AC filter
- Cooling fan for filter
- Charging resistors
- AC fuses (frames R11i and above)

IGBT Supply Unit The IGBT Supply Unit includes the parts listed below:

- Converter (ACN 634 xxxx)
- Converter cooling fans
- DC fuses
- the following control boards inside the converter:
  - Thick-film Hybrid Board (NRED) in 690 V units only for limiting the maximum voltage
  - Power Supply Board (NPOW)
  - Main Circuit Interface Board (NINT)
  - Control Distribution Board (NXPP) in frame sizes R10i to 4 x R12i
  - Gate Driver Power Supply Board (NGPS) in frame sizes R12i and up for supplying power to NGDR boards
  - Gate Driver Board (NGDR)

Converter The converter consists of an IGBT bridge which forms controlled d.c. voltage from the supply network a.c. voltage. The bridge is capable of delivering braking energy back to the network.

Frame Size	**A converter (ACN 634 xxxx) consists of**
R8i to R9i	one converter module
R10i to R12i	three phase modules (ACN 644 xxxx) = one converter 
2 x R11i, 2 x R12i	two times three phase modules (ACN 644 xxxx) = two phase module blocks ⇒ one converter 
4 x R11i, 4 x R12i	four times three phase modules (ACN 644 xxxx) = four phase module blocks ⇒ one converter 

Main Circuit Construction

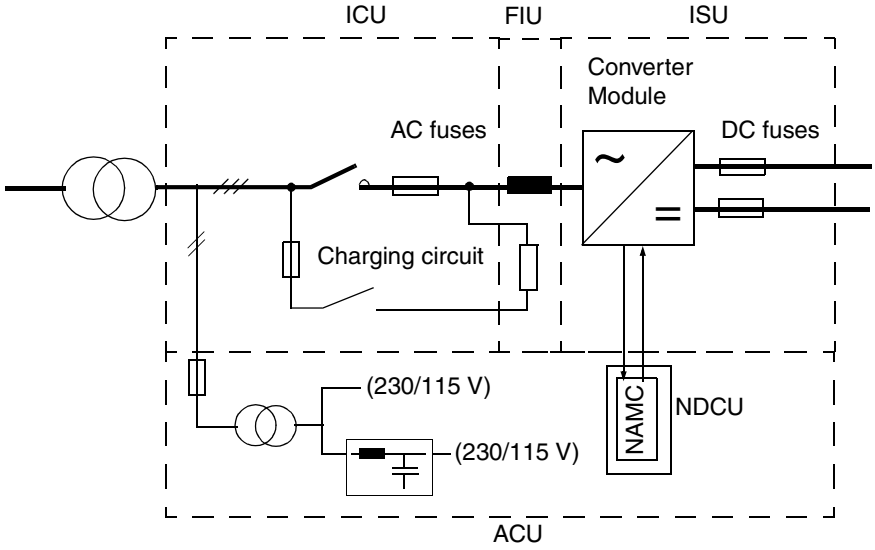
The converter consists of six insulated gate bipolar transistors (IGBT) with free wheeling diodes and DC capacitors. Frames R8i and R9i are equipped with parallel connected IGBTs for each phase located on three power plates. Frames R10i and R11i include six power plates and frame R12i nine power plates. An a.c. choke is connected between the supply transformer and the converter. The AC choke impedance is 20 percent of the nominal impedance of the ISU.

Configurations

The sections below describe possible configurations of ISU modules.

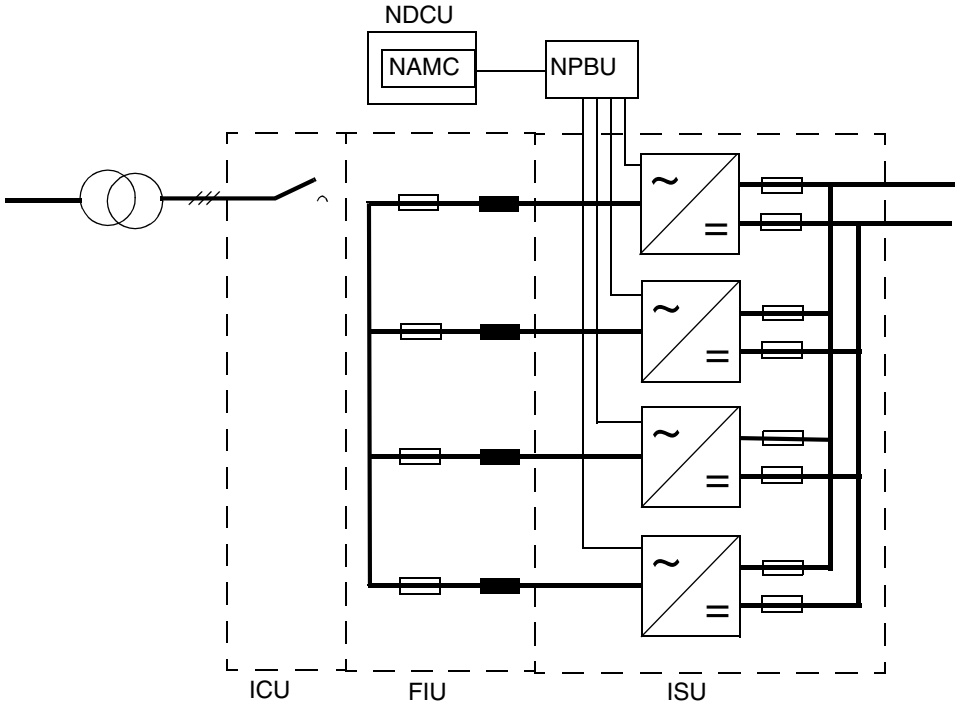
Basic Configuration

The hardware of the IGBT supply unit is equal to the hardware of the ACS 600 MultiDrive inverter. One NAMC board controls the converter module. It is located in the Auxiliary Control Unit inside the Drive Control Unit (NDCU) box as well as the NIOC board. The supply section is equipped with an a.c. reactor and AC and DC fuses.



Parallel Connected Modules

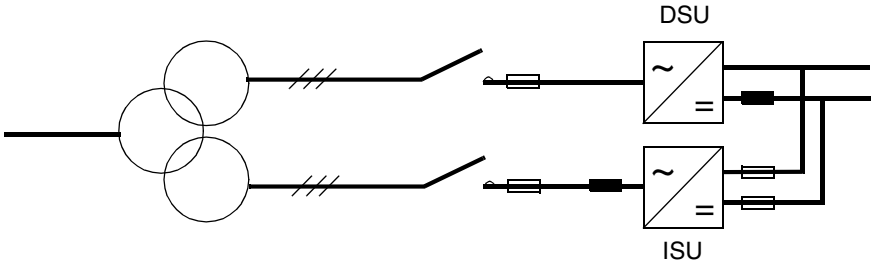
Parallel connected IGBT supply converter module configuration is equal to parallel connected inverter module configuration of the ACS 600 MultiDrive. One NAMC board controls all parallel connected modules. Each module is equipped with an a.c. reactor and AC and DC fuses. If one module fails, it can be disconnected by removing the fuses on both sides of it. The whole supply has a common disconnecting device. Full redundancy is not possible. The modules cannot supply the DC link separately, with independent NAMC boards.



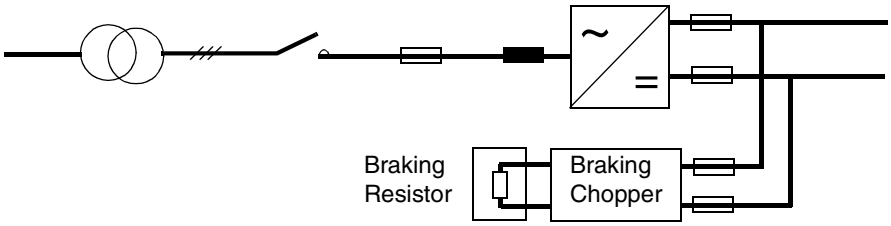
ISU and DSU in Parallel A diode supply unit must not be connected galvanically in parallel with an IGBT supply unit in the same a.c. supply as the synchronisation would fail. The parallel configuration is allowed only with a supply transformer equipped with two secondary windings. This configuration is beneficial when the motoring power is considerably higher than the braking power and the brakings are short.

Start mode DC LEVEL START (Parameter 21.01 value 1) must be used. During motoring the ISU is not modulating, only the free wheeling diodes are conducting. The motoring current is flowing mainly through the DSU diode bridge, because the line impedance of the ISU is a lot higher than the impedance of the DSU diode bridge.

Diagram An allowable parallel configuration of the ISU and the DSU is shown below.



Braking Chopper A braking chopper can be connected in parallel with an IGBT supply unit. The configuration is beneficial when the braking is continuous and the drive is not allowed to stop if the supply network trips for a short time.



Chapter 4 – Commissioning the Supply Section with ISU

Overview

This chapter describes the commissioning of a supply section that is equipped with the IGBT Supply Unit (ISU).

WARNING! Only qualified electricians are allowed to commission the drive. The *Safety Instructions* on the first pages of this manual must be followed. Ignoring the safety instructions can cause injury or death.

Installation Checklist

The installation must be checked before commissioning the supply section. This table refers to the more detailed instruction.

Action	Information
☐ Check that the mechanical and electrical installation of the frequency converter is inspected and OK. ☐ Ensure that the insulation resistance of the assembly is checked according to instructions given in the *Hardware Manual*.	See *ACS 600 MultiDrive Hardware Manual* (EN code: 63700118) or *ACx 6x7 Hardware Manual* (EN code:61329005). Refer to *Installation Checklist and Insulation Checks (Chapter 3).*
☐ Ensure that the surroundings and inside of the cabinet is free from dust and loose objects (like cable trimmings and other waste left from the installation).	After the start, the cooling air fans may suck nearby loose objects into the unit. This might cause failure and damage the unit.

Checks with No Voltage Connected

This table is a commissioning checklist for the supply section with no voltage connected.

Action	Information
WARNING! Ensure that the disconnector of the supply transformer is locked to open position, i.e. no voltage is, or can be connected to the drive inadvertently. Check also by measuring that there actually is no voltage connected.	
1. Air Circuit Breaker, Relays, Switches	
☐ If the supply section is equipped with an air circuit breaker, check the current trip levels of the air circuit breaker.	The trip levels have been preset at the factory. In most applications there is no need to change these settings.
☐ Check the settings of the relays for the emergency stop circuit.	See the circuit diagrams delivered with the device.
☐ Check the settings of the time relays.	See the circuit diagrams delivered with the device.
☐ Check the settings of other relays.	See the circuit diagrams delivered with the device.
☐ Check the settings of the breakers/switches of the auxiliary circuits.	See the circuit diagrams delivered with the device.
☐ Check that all breakers/switches of the auxiliary circuits are open.	
2. Supply Tripping Circuit	
☐ Check the operation of the supply transformer tripping option.	This is an optional feature. See the circuit diagrams delivered with the device.
3. Auxiliary Control Voltage Transformer	
☐ Check the wirings to the primary and secondary side terminals of the auxiliary control voltage transformer.	See the circuit diagrams delivered with the device for the correspondence between the wirings and the voltage levels.

Connecting Voltage to Auxiliary Circuits

This table describes how to connect voltage to the supply section input terminals and to the Auxiliary Control Unit (ACU) for the first time.

Action	Information
WARNING! When voltage is connected to the input terminals of the supply section, the voltage will also be connected to the auxiliary control unit and to auxiliary circuits - also to the ones wired to drive sections. Make sure that it is safe to connect voltage to the input terminals. Ensure that while the voltage is connected: • Nobody is working with the unit or circuits that are wired from outside into the cabinets. • The cabinet doors are closed.	
☐ Disconnect the 230 VAC cables that lead from the terminal blocks to the outside of the equipment and have not yet been checked, and the connections which may not yet have been completed. ☐ Make sure that the main contactor/air circuit breaker cannot inadvertently be remote controlled to close, e.g. by temporarily opening some connection in its control circuit. ☐ Be ready to trip the main breaker of the supply transformer in case anything abnormal occurs. ☐ Ensure that all cabinet doors are closed. ☐ Close the main breaker of the supply transformer. ☐ Close the main disconnecting switch of the supply section. ☐ Close the main disconnecting switch of the auxiliary circuit.	

Checks with Voltage Connected to Auxiliary Circuits

This table is a commissioning checklist for the supply section with voltage connected to the input terminals, and Auxiliary Control Unit (ACU).

Action	Information
WARNING! This section includes instructions for checking/measuring circuits under voltage. Only a qualified person is allowed to do the work. An appropriate and approved meter must be used. **IF IN DOUBT, DO NOT PROCEED!**	
☐ Ensure the actions described in section *Connecting Voltage to Auxiliary Circuits* are completed.	
☐ Measure phase voltages by using the switch and meter on the cabinet door.	This is an optional feature. If included, see the circuit diagrams delivered with the device.
☐ Check the secondary side voltage of the auxiliary voltage transformer. Close the protection switch on the secondary side.	See the circuit diagrams delivered with the device.
☐ Close the breakers of the auxiliary circuits one by one. Check each circuit by • measuring correct voltage in terminal blocks • checking the operation of the devices connected to the circuit.	***Note:*** The cooling fans of the IGBT supply unit will start after the main contactor is closed.
☐ Check for the correct connection from an external auxiliary voltage source (e.g. from an Uninterrupted Power Supply, UPS) to the auxiliary control unit.	This is an optional feature. If included, see the circuit diagrams delivered with the device.

Connecting Voltage to IGBT Supply Unit

This table describes how to connect voltage to the IGBT supply unit and the DC busbars for the first time.

Action	Information
WARNING! When connecting voltage to the IBGT supply unit, the DC busbars will become live, as will all the inverters connected to the DC busbars. Make sure that it is safe to connect voltage to the IBGT supply unit. Ensure that: • Nobody is working with the unit or circuits that are wired from outside into the cabinets. • All cabinet doors are closed.	
1. First Voltage Switch-on for the IGBT Supply Unit	
☐ If the supply section is equipped with an air circuit breaker, set the air circuit breaker current settings to 50% of the on-load values.	It is recommended to set relatively low current values at the first voltage switch-on.
☐ Ensure that all cabinet doors are closed.	
☐ Be ready to trip the main breaker of the supply transformer if anything abnormal occurs.	
☐ Close the main disconnecting switch of the supply section. Close the main contactor / air circuit breaker of the supply section.	
2. Air Circuit Breaker Current Settings	
☐ Increase the air circuit breaker current settings to the on-load values.	

Starting

This procedure instructs how to start the IGBT supply unit.

Action	Information
WARNING! When starting the IGBT supply unit, the DC busbars will become live, as will all the inverters connected to the DC busbars. Make sure that it is safe to start the IGBT supply unit. Ensure that: • Nobody is working with the unit or circuits that are wired from outside into the cabinets. • All cabinet doors are closed. • The covers of the motor terminal boxes are on.	
☐ Ensure the actions described in subsections *Checks with No Voltage Connected* and *Checks with Voltage Connected to Auxiliary Circuits* are completed. ☐ Be ready to trip the main breaker of the supply transformer if anything abnormal occurs. ☐ Close the main disconnecting switch of the auxiliary circuit. ☐ Close the main disconnecting switch of the supply section. ☐ Start the ISU: • reset the starting logic by the RESET button on the cabinet door. • turn the starting switch on the cabinet door from position 0 to 1, and • turn the starting switch to the START position and release it.	

Checks with ISU Supply Started

This table is a list of checks to be done after the IGBT supply unit is started and the DC busbars are live.

Action	Information
WARNING! This section includes instructions for checking/measuring circuits under voltage. Only a qualified person is allowed to do the work. An appropriate and approved measuring instrument must be used. **IF IN DOUBT, DO NOT PROCEED!**	
1. Basic Checks	
☐ Check that the cooling fan in the supply section rotates freely in the right direction, and the air flows upwards.	A paper sheet set on the lower gratings stays. Fan runs noiselessly.
FLOATING NETWORK (IT NETWORK)	
1. Earth Fault Protection Based on an Insulation Monitoring Device	
☐ Check the setting of Parameter 30.04 EXT EARTH FAULT, and the connection to DI4. ☐ Check the tuning of the insulation monitoring device for the earth fault protection (Bender). The insulation monitoring device is tuned at the factory. If further tuning is required, see the *IRDH265 Operating Manual* by Bender (code: TGH1249).	This is an optional feature (IRDH265-x). If included, see the circuit diagrams delivered with the device. For information on the protection principle see the *IRDH265 Operating Manual* by Bender (code: TGH1249) and *Chapter 5 – Earth Fault Protection*.
SYSTEM EARTHED NETWORK (TN NETWORK)	
1. Earth Fault Protection Based on Internal Current Measurement	
☐ Check the setting of Parameter 30.02 EARTH FAULT.	This is a programmable feature. For information on the protection principle see *Chapter 5 – Earth Fault Protection*

Parameters

The parameters of the ISU need not be set in a normal start-up procedure or in normal use.

Controlling the ISU with an Overriding System

This procedure instructs how to control or monitor the IGBT supply unit from an overriding system by using data sets 1 and 2 or 10 to 33 with DDCS and DriveBus communication protocols.

Action	Parameter
Set this parameter to MCW if the ISU will be controlled with an overriding system. Set to I/O if the ISU is only monitored.	98.01 COMMAND SEL
Set this parameter to FBA DSET1 or FBDSET 10 depending on what datasets the overriding system uses.	98.02 COMM MODULE
Connect the fibre optic cables to channel CH0 on the NAMC board.	
Set the node address and communication mode for channel CH0 as follows:	70.01 CH0 NODE ADDR 71.01 CH0 DRIVEBUS MODE ***Note:*** Setting of Par. 71.01 is valid after the next power-up.
Check that the communication is working.	
Set the delay time for a coommunication fault indication.	70.04 CH0 TIMEOUT
Select the action upon a communication fault on channel CH0.	70.05 CH0 COMM LOSS CTRL
Select RING, if channels CH0 on the NAMC boards are connected in a ring. The dafault setting STAR is typically used with DDCS branching units NDBU-85/95.	70.19 CH0 HW CONNECTION

With Bender's insulation monitoring device it's possible to set up two response values: ALARM1 and ALARM2. Both values have an own alarm LED, which illuminates if reading is below these selected response values.

In Case of an Earth Fault

An earth fault closes the measuring circuit. An electronic evaluation circuit calculates the insulation resistance which is indicated on an LC display or an external ohmmeter after the response time.

The alarm actions depend on the electric connection: for example ALARM1 may only give a warning and ALARM2 may trip the device.

Further Information

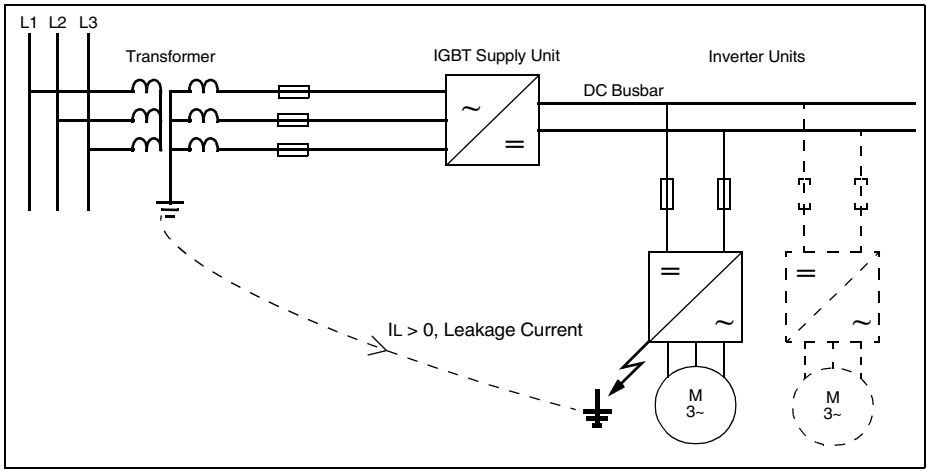
Further information about the insulation monitoring device is available in *IRDH265 Operating Manual (code TGH1249)* published by the manufacturer, BENDER companies.

System-earthed Network

In a system-earthed network, the neutral point of the supply transformer is earthed solidly. This section describes an internal earth fault protection principle in a system-earthed network.

Diagram

This diagram shows earth fault protection implemented with internal current transducers in the ACA 635.



Description

The line current unbalance is calculated from measured currents I_U, I_V and I_W.

In Case of an Earth Fault

In normal operation the current sum is zero. An earth fault leads to an unbalance in the 3-phase system and therefore to a current sum different from zero. If the current unbalance exceeds the limit set in Par. 30.03 EARTH FAULT LEVEL, an alarm is given or the device is tripped.

Chapter 6 – Firmware Description

Overview

This chapter describes the IGBT supply unit control program. ***Note:* The parameters listed in this chapter need not be set in normal use.** They are mentioned for explaining the control principle only.

The following symbols are used:

(1.10)	Actual signal or parameter (described in *Chapter 8 – Parameters*).
11.11	Parameter / actual signal below 100 (described in *Chapter 8 – Parameters*).
113.05	Parameter above 100. These parameters are not visible to the user unless passcode is entered for the Parameter Lock in Parameter 16.03 PASS CODE. These parameters are not allowed to be changed without ABB's permission.

Control Principle

The fundamental theory of line converter operation can be presented by an equivalent circuit with an AC choke and vector diagrams (below), where

____ motoring

_ _ _ generating

$\overline{U}_1$ network voltage vector

$\overline{U}_2$ line converter voltage vector

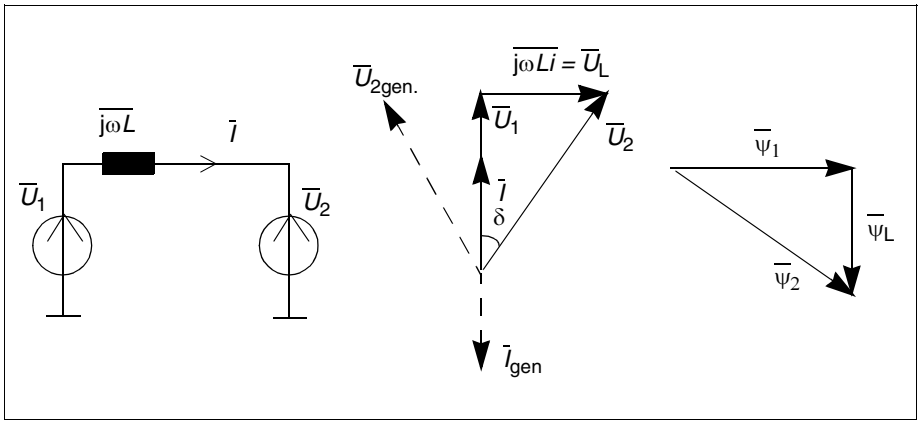
$\overline{U}_L$ AC choke voltage vector

$\overline{\psi}_1$ “network flux” vector

$\overline{\psi}_2$ “line converter flux” vector

$\overline{\psi}_L$ “AC choke flux” vector

δ power transfer angle.



The primary function of the ISU is to control the power transfer between the network and the DC link. The purpose of the AC choke (represented by reactance $X = j\omega L$) is to smooth the line current and to act as an energy storage for the switch-mode supply. Power transfer equation between the network and the ISU is presented below:

$$P = \frac{U_1 U_2}{X} \sin \delta$$

Real power is being transferred only if an angle difference exists between the two voltage vectors. Reactive power transfer equation is presented below:

$$Q = \frac{U_1^2}{X} - \frac{U_1 U_2}{X} \cos \delta$$

For the desirable magnitude and the direction of the power and reactive power flow, the length of the converter voltage vector and its phase angle δ (with respect to the line voltage vector) must be controlled. The d.c. voltage is controlled by keeping the power (energy) equilibrium between the line and the drives in the DC link constant. The sign of the angle determines the direction of the power flow.

The output a.c.voltage is controlled by setting the length of the flux reference to correspond to the desired output voltage level producing cosfii = 1.0.

The ISU control needs measurements of the DC link voltage and two line currents. The “stator flux” (integral of the voltage vector of the ISU) is calculated by integrating the voltage vector used to generate the output voltage of the ISU. This is due to the fact that the existing voltage in the network can be thought to be generated by a rotating magnetic flux encircled by coils. Each of these coils is one of the line voltage phases. The voltage in the coils can be expressed by the formula below:

$$\overline{U} = \frac{\overline{d\ \psi}}{dt}$$

The virtual torque generated by the ISU is calculated as a cross product of flux and current vectors:

$$T = \overline{\psi}\ x\ \overline{I}$$

Power can also be expressed as a product of torque and angular velocity:

$$P = \omega T$$

If the network frequency is constant, power is directly proportional to the torque. By controlling torque, power transferred between the ISU and the network can be set to a value that keeps the DC link voltage constant. These basic facts enable the use of the DTC method which relies on control of flux and torque.

The main difference between DTC and conventional PWM is that torque is controlled at the same time level as power switches (25 μs). There is no separate voltage and frequency controlled PWM modulator. All selections of the switches are based on the electromagnetic state of the ISU. This kind of control method can be realised only by using a high speed signal processing technology. The digital signal processor Motorola 56002 is used in the ACS 600 product family to achieve sufficient speed.

Identification Routine

The ISU adapts itself to the supply network and no data concerning the network conditions is to be set. The converter rating plate data is downloaded in the software package.

When the ISU is connected to the network for the first time a identification routine must be completed. The identification routine is executed each time after the NAMC board is powered.

The identification routine can be executed manually also after next start (without power up) by setting the Parameter 99.07 LINE SIDE ID RUN to YES and pressing the Control Panel Start key. This can be done if there is doubt that the automatic identification routine has failed, or an automatic routine is not desirable as it takes approximately 5 seconds and requires that the motor is not loaded.

The references 2.07 DC REF INITIALIZ and 150.01 FLUX REF USED NOM are calculated from internal DC link voltage measurement during the identification routine. If Par. 2.07 DC REF INITIALIZ exceeds the trip limit ($\sqrt{2}$ · the limit given in the description of Fault NET VOLT FLT) a fault is set (Parameter 9.11 bit 9 NET VOLT FLT). If the reference value is within allowed limits the procedure goes on further to define the frequency of the network (50 Hz or 60 Hz) and the phase order.

The parameters concerning the identification routine are presented below.

Code		Parameter	Unit	Description
99.07		LINE SIDE ID RUN		Manual identification run
99.08		AUTO LINE ID RUN		Automatic identification run
2.07	150.02	DC REF INITIALIZ	V	Nominal DC reference
	150.01	FLUX REF USED NOM	%	Nominal flux reference
	115.03	50 HZ IDENTIFICA		50 Hz network frequency (status)
	115.04	60 HZ IDENTIFICA		60 Hz network frequency (status)
	115.12	INITIALIZING DONE		Initialization completed (status)
		Fault		
9.11 bit 9		NET VOLT FLT		Supply voltage is not valid

Charging

When the control has received a start command, the charging contactor is closed. After the DC link voltage is high, the main contactor/breaker is closed and the charging contactor is opened. This procedure is controlled by the NAMC board via NIOC board digital outputs R01 to R03.

If the charging is not completed, i.e. the DC link voltage has not exceeded the value of Parameter 30.12 DC UNDERVOLT TRIP or the charging current is not below 5% of $I_{1base10s/60s}$, a fault is set (Parameter 9.11 SUPPLY FAULT WORD bit 0 CHARGING FLT**)**.

Synchronization

The ISU is synchronized to the network by two three-phase short-circuits of 200 μs in length at an interval of 6 ms. On the basis of the short-circuit current, the ISU can identify the phase order of the supply network and the starting point for the flux/voltage vector. The phase order of the supply can be changed without performing the identification routine again. The ISU must be stopped during a phase order change.

The synchronization can also be done with only one 200 μs short-circuit by Parameter 99.06 FAST SYNC selection YES. ***Note:*** In this case no phase order check is performed.

If a synchronization trial fails, the ISU makes up to 9 additional trials. One reason for a failed synchronization is too low a short-circuit current due to the high impedance of the network.

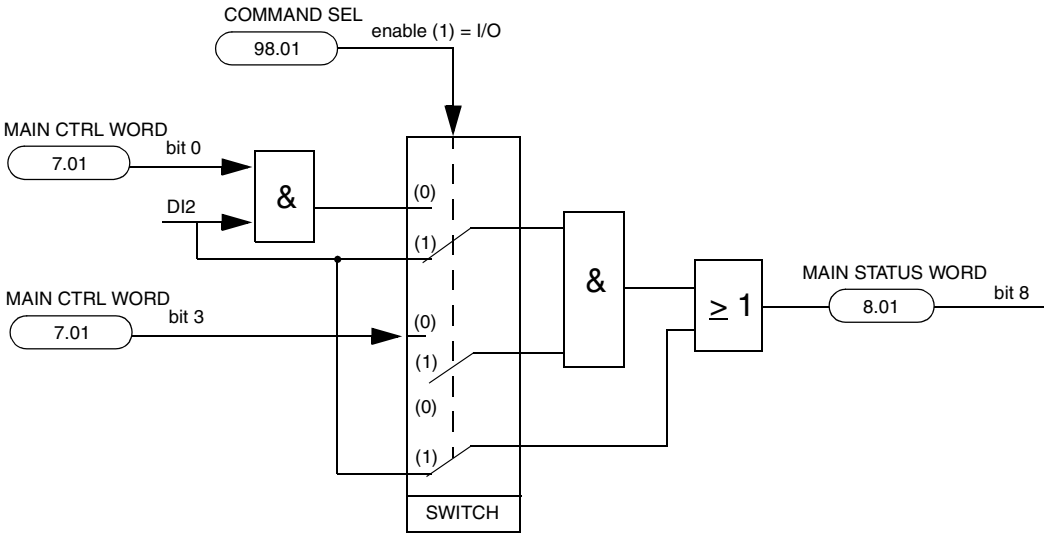
The synchronization parameters are listed below.

Code		Parameter	Unit	Description
	140.10	ZERO VECT LENGTH	200 μs	Length of the short-circuit pulse
	140.11	PHASE LOSS LIMIT	A	Current limit for short-circuit current
99.06		FAST SYNC		One short-circuit pulse is used
		Fault		
9.02		SUPPLY PHASE		Synchronization failed, phase(s) missing
9.11		SYNCHRO FLT		Synchronization failed, short-circuit current below limit

Starting Sequence

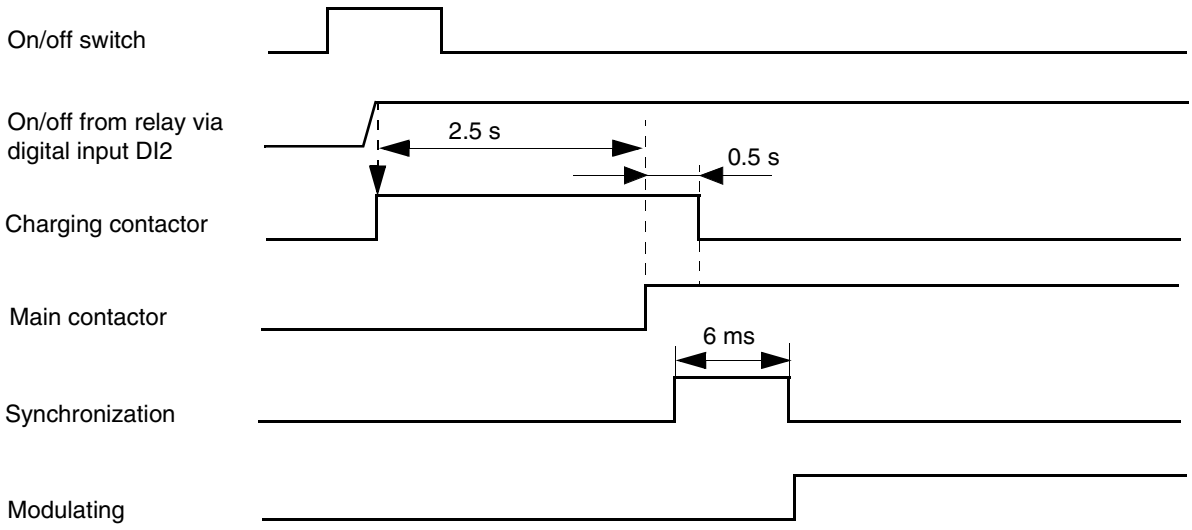
During the charging procedure the main contactor is closed, and after the synchronization routine is completed, the modulator is started and the ISU runs normally.

A simplified block diagram of the modulator starting (from starting switch on the cabinet door or via fieldbus) is presented below. For description of the starting procedure see the next pages.



Start by the Starting Switch

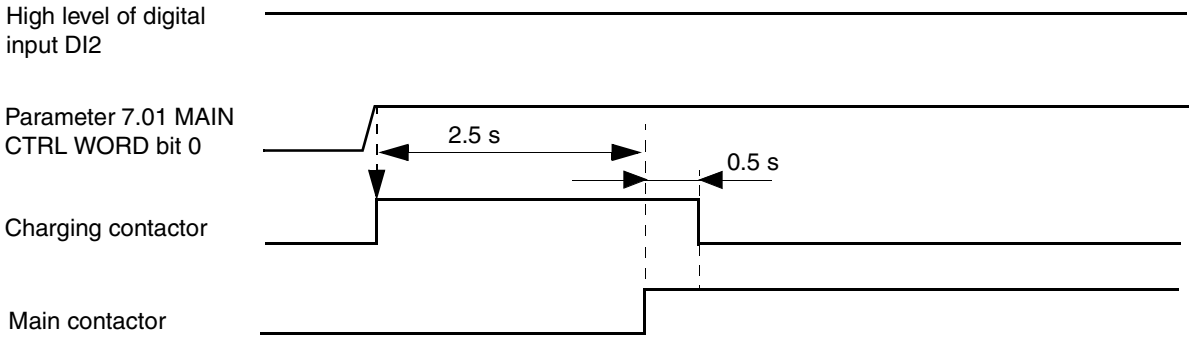
By default, the ISU control commands (ON/OFF) are given by the starting switch on the cabinet door which is wired to digital input DI2. The starting sequence is as follows:



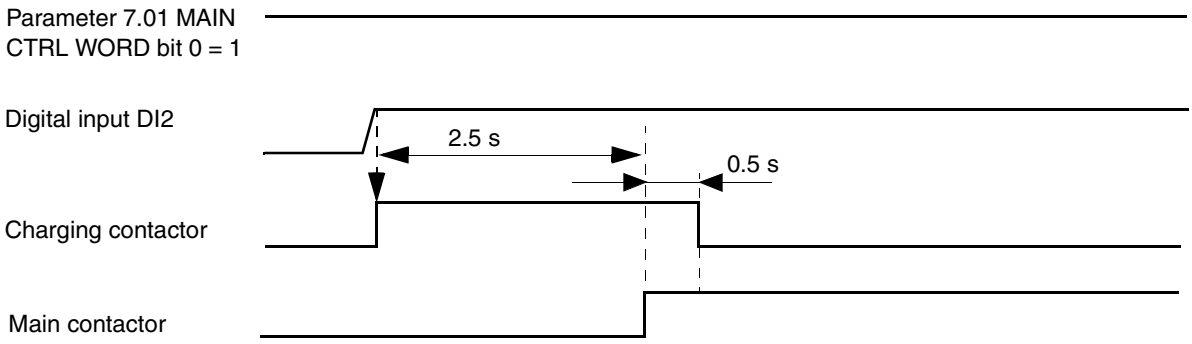
Step	Function
1.	ISU control receives the ON command (DI2 rising edge) from the starting switch.
2.	ISU control logic closes the charging contactor control circuit (RO1)
3.	ISU control logic closes the main contactor and cooling fan control circuit (RO3).
4.	ISU control logic receives the “main contactor on” acknowledgement (DI3).
5.	ISU control logic receives the “cooling air fan in operation” acknowledgement (DI1).
6.	ISU synchronizes itself to the supply network in case DC voltage is OK (charging is completed successfully).
7.	ISU control starts modulation. The inverter units can be started.

Start via Fieldbus To enable the fieldbus control Parameter 98.01 COMMAND SEL must be set to MCW. The DC bus can be charged and the modulator started separately via fieldbus. The DC bus can be charged in two ways:

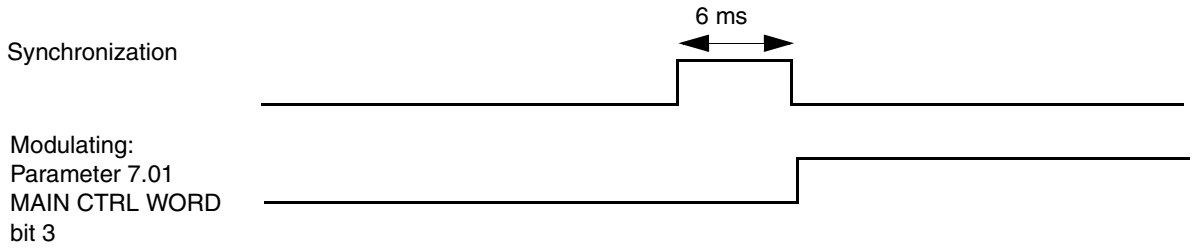
1. by rising edge of Parameter 7.01 MAIN CTRL WORD bit 0 and simultaneous high level of digital input DI2 (starting switch on the cabinet door in position 1).



2. by rising edge of digital input DI2 (from starting switch) and simultaneous high level of Parameter 7.01 MAIN CTRL WORD bit 0



The modulator is started by high level of Parameter 7.01 MAIN CTRL WORD bit 3, and stopped by low level of bit 3. The modulator can be started only after the charging of the DC bus is completed.



Level Start

Level Start is used with parallel connected DSU and ISU configurations. Level Start is enabled by Parameter 21.01 LEVEL START selection YES. In Level Start mode the ISU starts modulating after the DC link voltage exceeds a preset limit and modulates only when power flows from DC link to network. The DC voltage level to trigger the modulator is set by Parameter 21.02 DC VOLTAGE LEVEL.

When motoring power (positive direction from network to the DC link) exceeds Parameter 21.04 STOP LEVEL POWER for a time set by Parameter 21.03 STOP LEVEL TIME, the modulator is stopped. Parameter 21.04 STOP LEVEL POWER is always positive because stopping the ISU during braking is not desirable.

Parameters affecting Level Start mode are listed below.

Code		Parameter	Unit	Description
21.01		DC LEVEL START		Enables level start
21.02		DC VOLTAGE LEVEL	V	High level start condition
21.03		STOP LEVEL TIME	s	Stop condition time
21.04		STOP LEVEL POWER	kW	Stop condition power

Stop

A stop signal from the on/off switch on the cabinet door is disabling the modulator and opening the main contactor. The modulator can be stopped also from the ⓞ key on the Control Panel and from Drive*Window* in local mode, and from an overriding system in remote mode. These functions do not open the main contactor.

When the modulator is stopped in local mode or by an overriding system, the ISU moves to 6-pulse diode bridge mode. The nominal references, Parameters 2.07 DC REF INITIALIZ and 150.01 FLUX REF USED NOM, are updated, if Parameter 124.04 STOP INIT DENIED is set to FALSE.

Stop parameters are listed below.

Code		Enable Parameter	Unit	Description
	124.04	STOP INIT DENIED		Denies update of nominal DC reference when set to TRUE.
		Output Parameters		
2.07	150.02	DC REF INITIALIZ	V	Nominal DC voltage reference
	150.01	FLUX REF USED NOM	%	Nominal flux reference

Missing Phase

There is no direct a.c. voltage measurement in the ISU. The lost supply voltage is identified with current and DC voltage measurement.

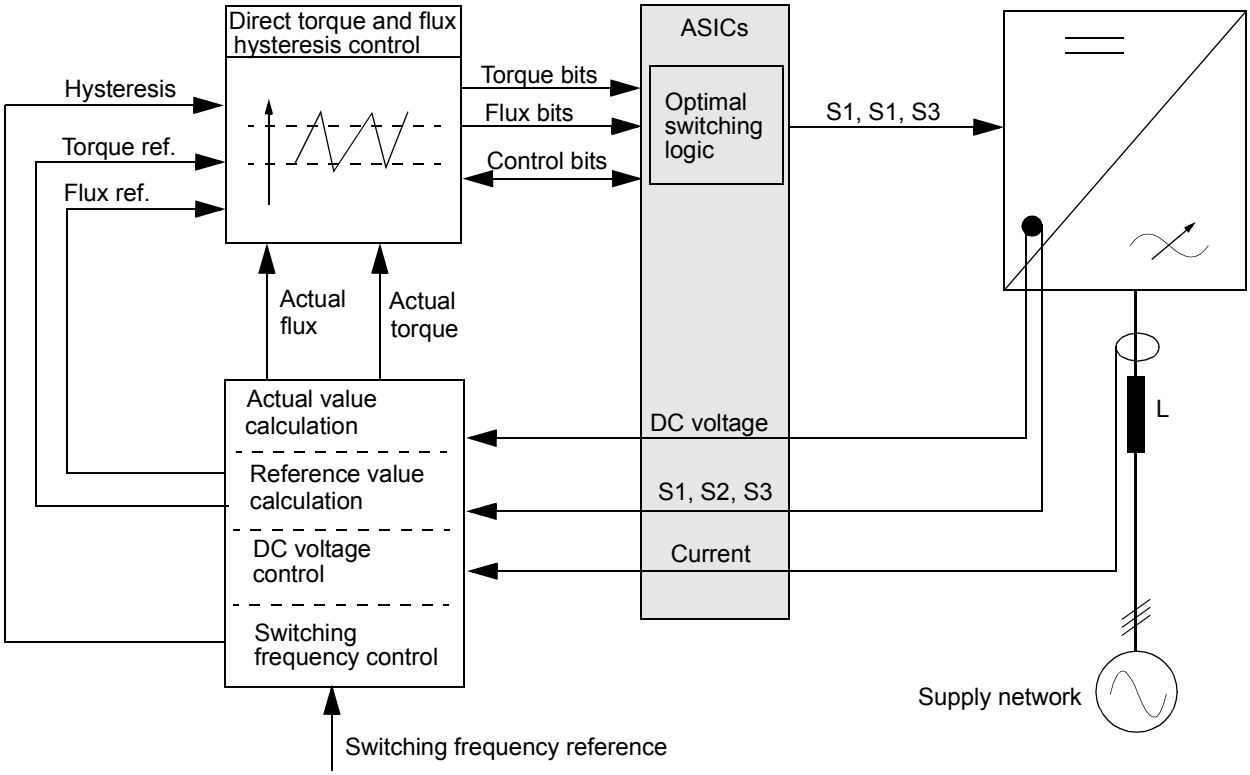
When the ISU detects that the current has been below the value of Parameter 142.01 NET LOST CUR LIM for the time defined by Parameter 142.02 ZERO CUR DELAY**,** an alarm (Parameter 9.12 SUPPLY ALARM WORD bit 10 NET LOST) is generated. The ISU tries to resynchronize as long as the DC voltage is greater than (Par. 2.07 DC REF INITIALIZ - Par. 142.04 DC START DEV NET). The resynchronizing checks are made at intervals defined by Parameter 142.03 NET TEST DEL. If the voltage in the DC link falls below the limit defined by Par. 145.04 DC UNDERVOLT TRIP, the ISU will open the main contactor/breaker and a fault (Parameter 9.11 bit 14 DC UNDERVOLT) is generated.

The sensitivity to the detection of a missing supply phase can be set by the following parameters:

Code		Parameters	Unit	Description
	142.01	NET LOST CUR LIM	A	Current limit for supply lost
	142.02	ZERO CUR DELAY	ms	Time delay for detection
	142.03	NET TEST DEL	ms	Time between supply back checks
	142.04	DC START DEV NET	V	Allowed DC voltage measurement deviation from Par. 2.07 DC REF INITIALIZ before resynchronization
	145.04	DC UNDERVOLT TRIP	V	Undervoltage tripping limit
		Alarm		
9.12 bit 10		NET LOST		Supply lost alarm
		Fault		
9.11 bit 14		DC UNDERVOLT		Undervoltage tripping

Control Diagram

A block diagram of the measurements and principle of the ISU control program is shown below. S1, S2 and S3 denote the power switches.



Controllers

The control includes two main controllers:

- torque and flux hysteresis control
- dc voltage controller

On the basis of measurements the following items are calculated:

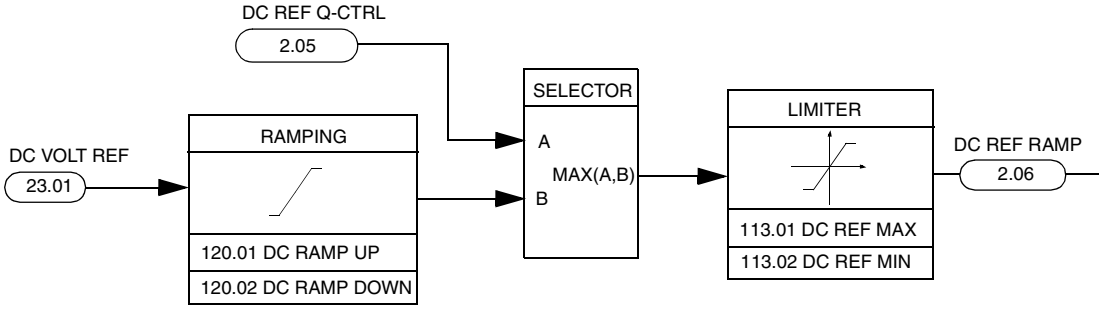
- actual value for flux
- actual value for torque
- actual value for reactive power
- estimate for frequency

DC References The ISU control has two reference values for the DC voltage control:

- Parameter 23.01 DC VOLT REF (user given reference)
- Parameter 2.05 DC REF Q-CTRL.

DC reference chain is initialized during synchronization. The value of Par. 2.07 DC REF INITIALIZ is copied to parameters 2.05 DC REF Q-CTRL and 2.06 DC REF RAMP.

Reference Selection A block diagram of reference selection (Parameter 23.01 DC VOLT REF / Parameter 2.05 DC REF Q-CTRL) after synchronization is shown below.

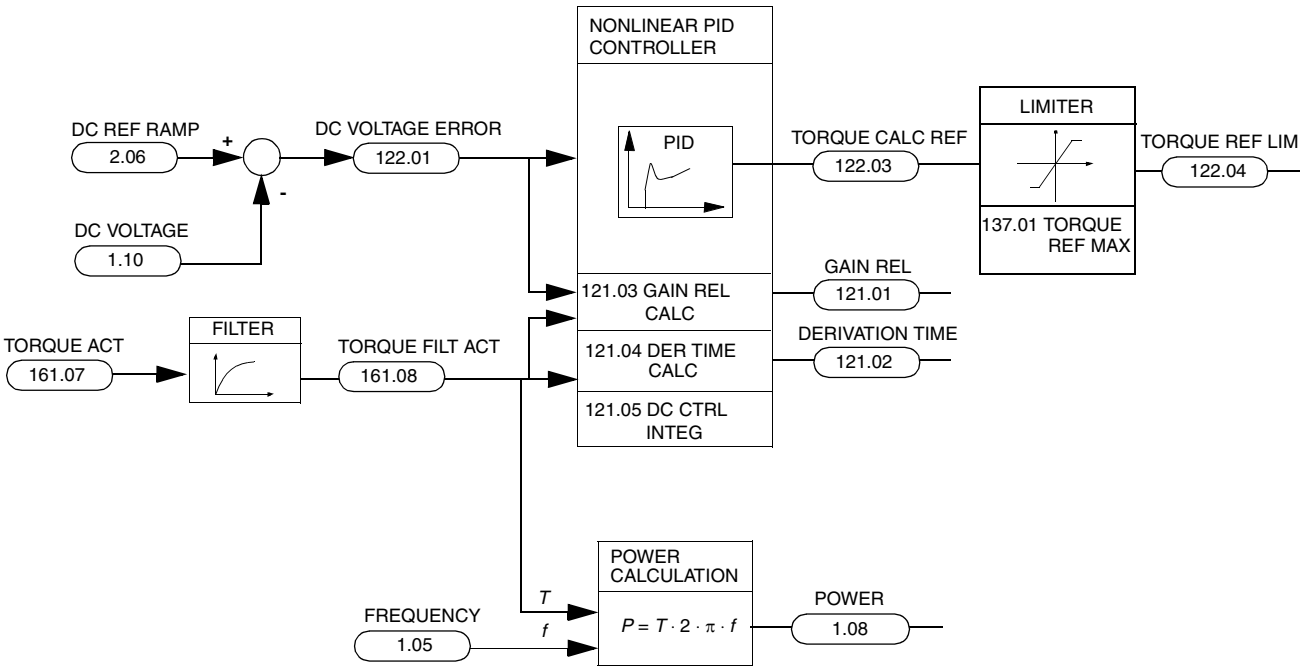


In normal mode the ramped value of Parameter 23.01 DC VOLT REF is selected, if it is higher than Parameter 2.05 DC REF Q-CTRL. The DC reference ramping times are set by Parameters 120.01 DC UP TIME and 120.02 DC DOWN TIME. Minimum and maximum values for the DC reference are set by Parameters 113.01 DC REF MAX and 113.02 DC REF MIN.

Reference List The references are listed below.

Code		Parameter	Description
23.01		DC VOLT REF	User given reference
	113.01	DC REF MAX	Upper limit for the reference
	113.02	DC REF MIN	Lower limit for the reference
	120.01	DC RAMP UP	Ramp up time
	120.02	DC RAMP DOWN	Ramp down time
		Actual Value	
2.05	113.05	DC REF Q-CTRL	Reference from cosfii control
2.07	150.02	DC REF INITIALIZ	Initialized reference
2.06	122.02	DC REF RAMP	Ramped and limited reference

DC Voltage Controller The DC voltage controller is the primary controller for the ISU. A block diagram of the DC voltage controller is presented below.



The DC voltage controller keeps the DC voltage in a preset reference in all load conditions. An error signal is calculated from DC voltage measurement (Actual Signal 1.10 DC VOLTAGE) and Actual Signal 2.06 DC REF RAMP. The gain (Parameter 121.03 GAIN REL CALC) and derivation time (Parameter 121.04 DER TIME CALC) of the PID controller depend on signals 122.01 DC VOLTAGE ERROR and 161.08 TORQUE FILT ACT. Parameters 121.01 GAIN REL CALC and 121.02 DERIVATION TIME are used to calculate the output of the PID algorithm. The output of the DC voltage controller is Parameter 122.04 TORQUE REF LIM, which is used as torque reference for hysteresis control. The sign of rotation (supply phase order) determines the sign of torque reference.

The PID controller parameters are pretuned. There is no need to retune them.

The active power is calculated as a product of angular velocity and torque seen by the ISU. Positive power means power flow from the supply network to the DC link.

The parameters and actual values of DC voltage control are listed below.

Code		Parameter	Unit	Description
	121.01	GAIN REL	%	Initial gain
	121.02	DERIVATION TIME	ms	Initial derivation time
	121.03	GAIN REL CALC	%	Calculated relative gain
	121.04	DER TIME CALC	ms	Calculated derivation time
	121.05	DC CTRL INTEG	ms	Initial integration time
		Actual Value		
	161.07	TORQUE ACT	%	Nonfiltered torque value
	161.08	TORQUE FILT ACT	%	Filtered torque value
1.05	161.09	FREQUENCY	Hz	Calculated line frequency
1.08	161.13	POWER	kW	Active power
1.10	160.04	DC VOLTAGE	V	Actual DC voltage
	122.01	DC VOLTAGE ERROR	V	Error value between reference and actual voltage
	122.03	TORQUE CALC REF	%	PID controller output
	122.04	TORQUE REF LIM	%	Torque hysteresis controller input

Current Limit Control

Because of the free wheeling diodes on the power plates, the modulating ISU cannot limit the current when power flows from supply network to the DC link. If the motoring power of the inverters increases momentarily from the nominal level (allowed short term overload level), current will flow from the network to the capacitors regardless of the control. The waveform changes from sinusoidal to diode bridge mode waveform, in which current peaks are considerably higher with the same power. Overcurrent tripping limit is 98 percent of the maximum value of the converter current measuring range (Parameter 4.08 CONV MAX CURRENT).

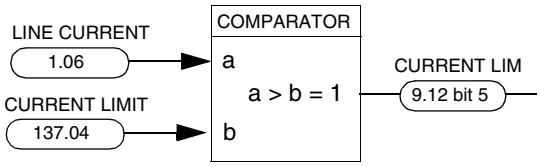
During regeneration (braking) the current can be limited by means of Parameter 137.01 TORQUE REF MAX. The calculated torque reference (Parameter 122.03 TORQUE CALC REF) is limited to the absolute value of Parameter 137.01 TORQ REF MAX, which is 220 percent of the ISU nominal “torque”. Current limitation will cause a voltage rise in the DC link. When the voltage reaches the limit of Parameter 145.03 DC OVERVOLT TRIP, bit 15 DC OVERVOLT of Parameter 9.11 SUPPLY FAULT WORD will be set and the ISU will trip.

An alarm (Parameter 9.12 SUPPLY ALARM WORD bit 5 CURRENT LIM) is generated, when the line current (Actual Signal 1.06 LINE CURRENT) is exceeds the value of Parameter 137.04 CURRENT LIMIT. Par. 137.04 CURRENT LIMIT is 220 percent of Parameter 112.02 HEAVY DUTY CUR which equals to $I_{1base\ (10s/60s)}$. This limit is so close to the overcurrent trip limit, that an alarm is rarely generated (before an overcurrent trip).

When the current limit alarm is active, the internal control first lowers the ramped reactive power reference (when Par. 24.01 Q POWER REF is not zero) controlling the current towards the current limit. In case the current limit is not reached (when the ramped reactive power reference has been controlled to zero), the internal control, secondly, lowers the ramped d.c. reference, further controlling the current towards the current limit. In case the current limit is still not reached (current limit alarm is still active and the ramped d.c.reference equals the value of Par. 2.05 DC REF Q-CTRL), the current can be lowered by limiting inverter actual power.

The alarm is removed when the current falls below the current limit.

A block diagram of the current limit alarm is presented below.



The current limit parameters are presented below.

Code		Parameter	Unit	Description
	137.04	CURRENT LIMIT	%	Current limit
	137.01	TORQUE REF MAX	%	Absolute torque limit
1.06	161.03	LINE CURRENT	A	Measured line current (actual value)
	145.03	DC OVERVOLT TRIP	V	
		Alarm		
9.12 bit 5		CURRENT LIM		Current limit alarm
		Fault		
9.01 bit 1		OVERCURRENT		Overcurrent fault
9.11 bit 15		DC OVERVOLT		DC overvoltage fault

Reactive Power Control

The base value for the flux reference is Parameter 150.01 FLUX REF USED NOM. The DC voltage and output voltage references are defined during identification routine for setting cosfii to 1.0. However, the voltage level in the network can fluctuate greatly. To have cosfii equal to 1.0 at every point, the DC voltage and output voltage references have to be adapted.

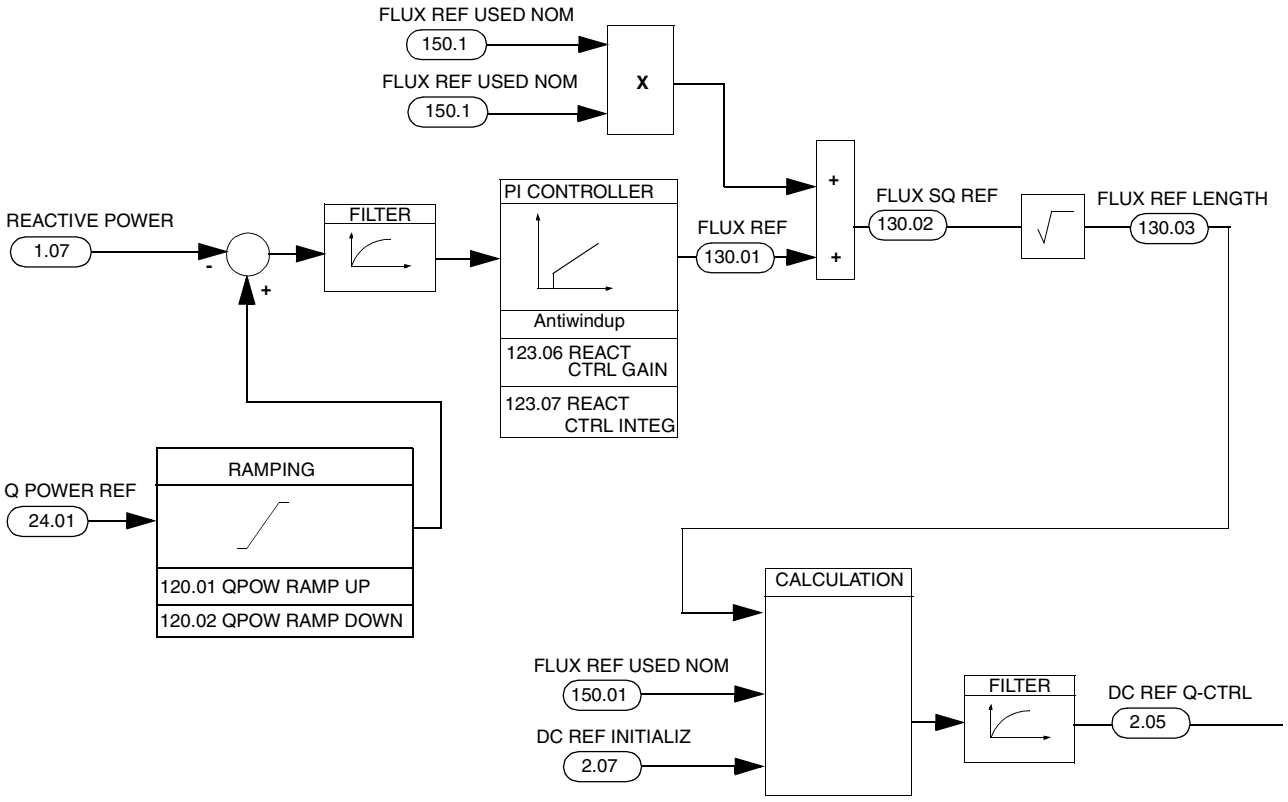
The reactive power control sets the output voltage reference (Actual Signal 2.05 DC REF Q-CTRL) and the flux length reference (Parameter 130.02 FLUX SQ REF) to values with which zero reactive power is achieved.

Reactive power control is capable of generating a preset amount of reactive power (Parameter 24.01 Q POWER REF) to the network (positive = capacitive, negative = reactive) by changing the flux length. Increasing the ISU flux length higher than the network flux length, capacitive power is generated to the network and vice versa. Increased flux means that the output voltage of the ISU is higher than the network voltage.

Reactive power control parameters are listed below.

Code		Parameter	Unit	Description
2.07	150.02	DC REF INITIALIZ	V	Nominal DC voltage
	150.01	FLUX REF USED NOM	%	Nominal flux reference
2.05	113.05	DC REF Q-CTRL	V	DC voltage reference from cosfii control
	130.02	FLUX SQ REF	%	Squared flux reference from cosfii control
24.01	123.04	Q POWER REF	%	Reactive power in percentage of the nominal power
1.07	161.15	REACTIVE POWER	kVAr	Calculated reactive power
	120.03	QPOW RAMP UP	s	Ramp up time
	120.04	QPOW RAMP DOWN	s	Ramp down time
	130.01	FLUX REF	%	PI controller output
	130.03	FLUX REF LENGTH	%	Flux reference from cosfii control

A block diagram of reactive power control is shown below.



Chapter 7 – Fault Tracing

Overview

This chapter explains the ACA 635 fault tracing procedure with the Control Panel. For Control Panel use and motor-side inverter fault tracing, see the *Firmware Manual* of the application program.

All Warning and Fault messages of the ACA 635 are presented in tables below with information on the cause and remedy for each case. Most Warning and Fault conditions can be identified and cured with that information. If not, contact an ABB service representative. For specific instructions on when/how to change control boards or their wiring or power plates refer to *ACS 600 Service Manual* (EN code: 64401131).

CAUTION! Do not attempt any measurement, parts replacement or other service procedure not described in this manual. Such action will void guarantee, endanger correct operation, and increase downtime and expense.

WARNING! All electrical installation and maintenance work described in this chapter should only be undertaken by a qualified electrician. The *Safety Instructions* on the first pages of this manual must be followed.

Fault Tracing

The ACA 635 is equipped with advanced protection features that continuously guard the unit against damage and down time due to incorrect operating conditions and electrical and mechanical malfunctions.

The warning message disappears when any of the Control Panel keys are pressed. The warning will reappear in one minute if conditions remain unchanged. If the frequency converter is operated with the Control Panel detached, the red LED in the Control Panel mounting platform indicates fault condition.

For setting of programmable warning and fault messages and functions, refer to *Chapter 8 – Parameters.*

Fault Resetting

An active fault can be reset either by pressing the keypad ***RESET*** key, by digital input or fieldbus, or switching the supply voltage off for a while. When the fault has been removed, the ACA 635 can be started.

Fault History

When a fault is detected, it is stored in the Fault History. The last faults and warnings are stored with the time the fault was detected.

WARNING! After a fault reset, the ACA 635 will start if the start signal is on. Before the reset, switch off the external start signal or ensure that it is safe to start.

The Fault History can be viewed by pressing ▲ or ▼ in the Actual Signal Display Mode. The Fault History can then be scrolled with ▲ and ▼. To exit the Fault History press ▲ or ▼. The Fault History can be cleared by pressing the ***RESET*** key.

Fault and Warning Messages

The tables below show the warning and fault messages.

Warning Messages

Warning	Cause	What to do
ACS 600 TEMP Par. 9.12 bit 4	The ACS 600 internal temperature is excessive. A warning is given if the converter module temperature exceeds 115 °C.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check line current against unit current.
AI<MIN FUNC Par. 9.12 bit 3	I/O reference 4...20 mA is below 3.1 mA when Par. 13.06 MINIMUM AI2 or Par. 13.10 MINIMUM AI3 is set to 4 mA.	Check for proper analogue control signal level. Check the control wiring.
CH0 TIMEOUT Par. 9.12 bit 0	Communication break detected on CH0 receive. (can be deactivated: see Parameter 70.04)	Check the fibre optic cables between the NAMC board and overriding system (or fieldbus adapter). Test with new fibre optic cables. Check that the CH0 node address (Par. 70.01 CH0 NODE ADDR) is correct in the ISU. Check the status of the fieldbus adapter. See appropriate fieldbus adapter manual. Check parameter settings of Group 51, if a fieldbus adapter is present. Check the connections between the fieldbus and the adapter. Check that the bus master is communicating and correctly configured.
CURRENT LIM Par. 9.12 bit 5	Current limit is exceeded. The limit is 220 % of $I_{1base(10s/60s)}$.	Limit inverter actual power or lower the reactive power percentage in Par. 24.01 Q POWER REF.
DI5 = 0 Par. 9.12 bit 14	Digital input DI5 is OFF (0).	Check the function indicated via digital input DI5.
E EARTH FLT Par. 9.12 bit 13	IT Network Impedance between a live part (e.g. phase conductor, DC link, motor cable or motor) and earth/ground is too low. Earth fault in AC filter, line converter, DC link, inverter(s), motor cables or motor.	Check motors. Check motor cables. Check ISU. Check inverter(s). Check AC filter.

Warning Messages

Warning	Cause	What to do
EARTH FAULT Par. 9.12 bit 13	Earthed/Grounded Network The sum of line currents measured with internal current transducers is too high. Earth fault in AC filter, line converter, DC link, inverter(s), motor cables or motor, or current unbalance in parallel connected converters.	Check motors. Check motor cables. Check the ISU fuses (parallel connected units). Check the ISU. Check inverter(s). Check AC filter.
NET LOST Par. 9.12 bit 10	Network voltage is lost during modulation. Line current is below 0.0064 · $I_{1base\ (10s/60s)}$. The situation may cause DC link undervoltage.	Check network conditions.
PANEL LOST Par. 9.12 bit 1	A Local Control device (CDP 312 or Drive*Window)* has ceased communicating. This can be caused by the disconnection of the selected local control device during local control or an internal fault in the local controlling device. This warning transfers the ISU to remote mode.	Check Control Panel connector. Replace Control Panel in the mounting platform.
NO COMMUNICATION (x)	This message is generated by the Control Panel CDP 312 control program. There is a cabling problem or a hardware malfunction on the Panel Link. (4) = Panel type is not compatible with the version of the converter application program.	Check the Panel Link connections. Press the RESET key. The panel reset may take up to half a minute, please wait. Check the Panel type and the version of the drive application program. The Panel type is printed on the cover of the Panel.
ID N CHANGED	The ID number of the ISU has been changed from 1 (the change is not displayed on the Control Panel CDP 312).	To change the ID number back to 1 go to Drive Selection Mode by pressing ***DRIVE***. Press ***ENTER***. Set the ID number to 1. Press ***ENTER.***
LOAD FACTORY	Factory parameter settings are being restored.	Please wait.

Fault Messages

Fault Text	Cause	What to do
ACS 600 TEMP Par. 9.01 bit 3 Par. 9.11 bit 3	The ACS 600 internal temperature is excessive. The trip level of the converter module temperature is 125 °C.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check line current against unit current.
AMBIENT TEMP Par. 9.02 bit 7	I/O control board temperature is lower than +5 °C or exceeds +73 °C.	Check ambient temperature in the auxiliary control unit (ACU).
CHARGING FLT Par. 9.11 bit 0	DC link voltage is not high enough after charging procedure. DC link voltage has not exceeded the value of Par. 30.12 DC UNDERVOLT TRIP or current is not below 5% of $I_{1base\ (10s/60s)}$ at the end of the charging.	Check charging circuit fuses. Check charging circuit. Check possible short-circuit in DC link. Check the setting of Par. 30.12 DC UNDERVOLT TRIP.
	Faulty PPCC link (DC voltage measurement is zero).	Check the PPCC link. See fault message PPCC LINK.

Fault Messages

Fault Text	Cause	What to do
CH0 COM LOST Par. 9.02 bit 12 Par. 9.11 bit 10	Communication break detected on CH0 receive. (programmable fault, see Parameter 70.05)	Check the fibre optic cables between the NAMC board and overriding system (or fieldbus adapter). Test with new fibre optic cables. Check that the CH0 node address (Parameter 70.01) is correct in the ISU. Check the status of the fieldbus adapter. See appropriate fieldbus adapter manual. Check parameter settings of Group 51, if a fieldbus adapter is present. Check the connections between the fieldbus and the adapter. Check that the bus master is communicating and correctly configured.
DC OVERVOLT Par. 9.01 bit 2 Par. 9.11 bit 15	Intermediate circuit DC voltage is excessive. This can be caused by 1. static or transient overvoltages in the mains. 2. too high supply voltage during synchronisation. The default trip limit is 740 V d.c for 415 V units, 891 V d.c for 500 V units and 1230 V d.c for 690 V units. The trip limit can be changed with Par. 30.11 DC OVERVOLT TRIP.	Check the level of supply voltage, DC voltage and converter nominal voltage.
DC UNDERVOLT Par. 9.02 bit 2 Par. 9.11 bit 14	Intermediate circuit DC voltage is not sufficient. This can be caused by a missing mains phase, a blown fuse or a rectifier bridge internal fault. The default trip limit is 293 V d.c for 415 V units, 354 V d.c for 500 V units and 488 V d.c for 690 V units. The tip limit can be changed with Par. 30.12 DC UNDERVOLT TRIP.	Check supply and inverter fuses. Check supply voltage.
DI5 = 0 Par. 9.11 bit 2	Digital input DI5 is OFF (0).	Check the function indicated via digital input DI5.
E EARTH FLT Par. 9.11 bit 4	IT Network Impedance between a live part (e.g. phase conductor, DC link, motor cable or motor) and earth/ground is too low. Earth fault in AC filter, line converter, DC link, inverter(s), motor cables or motor.	Check motors. Check motor cables. Check ISU. Check inverter(s). Check AC filter.
EARTH FAULT Par. 9.01 bit 4 Par. 9.11 bit 12	Earthed/grounded Network The sum of line currents measured with internal current transducers is too high. Earth fault in AC filter, line converter, DC link, inverter(s), motor cables or motor, or current unbalance in parallel connected converters.	Check motors. Check motor cables. Check the ISU fuses (parallel connected units). Check the ISU. Check inverter(s). Check AC filter.

Fault Messages

Fault Text	Cause	What to do
FAN FLT Par. 9.11 bit 5	Fan is not rotating, or contactor connection is loose.	Check the acknowledge circuit connection to the digital input DI1. Check the condition of the bearings of the fan motor by rotating fan motor manually. If the bearings are faulty replace the fan (available as spare part). Replace the fan if trippings continue and the bearings are OK.
IO FAULT Par. 9.02 bit 6	I/O communication fault or error detected on CH1. This can be caused by a fault in the NIOC board or a faulty/loose fibre optic cable connection.	Check for loose connections between the NIOC and NAMC board. Test with new fibre optic cables. If the fault is still active, replace the NIOC board.
MAIN CNT FLT Par. 9.11 bit 6	Main contactor is not functioning properly, or loose wiring.	Check main contactor control circuit wiring and signal wiring. Check main contactor control voltage level (should be 230 V).
NET VOLT FLT Par. 9.11 bit 9	Mains voltage is out of allowable range during synchronisation or ID Run. Trip limits are 208 V for 415 V units, 250 V for 500 V units and 345 V for 690 V units.	Check mains voltage. Start again.
OVER SWFREQ Par. 9.02 bit 9	Switching overfrequency fault. This may be due to a hardware fault in the electronic boards.	Replace the NAMC board. Replace the NINT board. On units with parallel connected inverters, replace the NPBU board.
OVERCURRENT Par. 9.01 bit 1 Par. 9.11 bit 1	Input current is excessive. The overcurrent trip limit is 0.98 · (Par. 4.08 CONV MAX CURRENT). The trip limit is approximately 190 % of the converter nominal current I_{1N} (Par. 4.05 CONV NOM CURRENT).	Check motor load. Check supply voltage. Check that there is no power factor compensation capacitors in the supply. Check ISU power semiconductors and current transducers.
PPCC LINK Par. 9.02 bit 11	NINT board current measurement or communication fault between the NAMC and NINT boards. The fault indication is not activated, when the DC link voltage is disconnected, but the NAMC board has an external power supply. The indication is activated when the charging is completed and the DC link voltage is “high”.	Check the fibre optic cables connected between the NAMC and NINT boards. In parallel connected inverters, also check the cabling on the NPBU-xx board. If the fault is still active, replace the NPBU board (only with parallel connected inverters), NAMC and NINT board (in this order) until the fault disappears. Test with new fibre optic cables in the PPCC (power plate control board) link.
SHORT CIRC Par. 9.01 bit 0	Short-circuit current has been detected on a power plate.	Measure the resistance of the power plate(s). If a faulty power plate is detected, replace the power plate and the NINT and NGDR boards, or change the whole converter phase module. Check the main circuit.

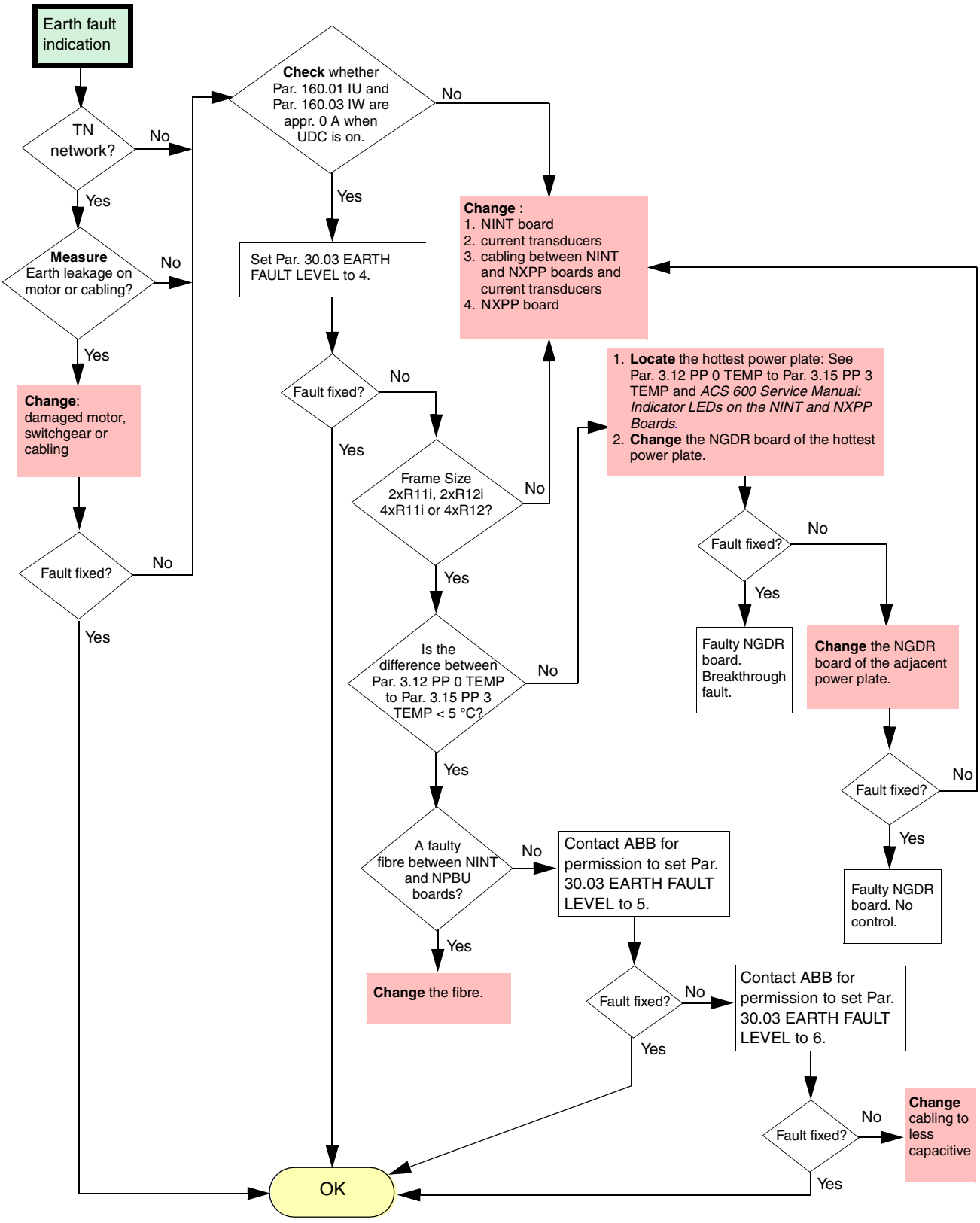
Fault Messages		
Fault Text	**Cause**	**What to do**
SC (INU 1) Par. 9.01 bit 12	Short-circuit in parallel connected phase module block 1	Check the fibre optic cables between the NPBU board channel CH1 and the NINT board of phase module block 1. Check the motor and the motor cable. Check all power plates in the phase module block 1. If a faulty power plate is detected, replace the whole phase module.
SC (INU 2) Par. 9.01 bit 13	Short-circuit in parallel connected phase module block 2	Check the fibre optic cables between the NPBU board channel CH1 and the NINT board of phase module block 2. Check the motor and the motor cable. Check all power plates in the phase module block 2. If a faulty power plate is detected, replace the whole phase module.
SC (INU 3) Par. 9.01 bit 14	Short-circuit in parallel connected phase module block 3	Check the fibre optic cables between the NPBU board channel CH1 and the NINT board of phase module block 3. Check the motor and the motor cable. Check all power plates in the phase module block 3. If a faulty power plate is detected, replace the whole phase module.
SC (INU 4) Par. 9.01 bit 15	Short-circuit in parallel connected phase module block 4	Check the fibre optic cables between the NPBU board channel CH1 and the board of phase module block 4. Check the motor and the motor cable. Check all power plates in the phase module block 4. If a faulty power plate is detected, replace the whole phase module.
SUPPLY PHASE Par. 9.02 bit 0	Missing phase during synchronisation	Check supply fuses. Check for supply network unbalance.
SYNCHRO FLT Par. 9.11 bit 13	Synchronisation to supply network is failed. Supply frequency has changed too much after ID Run.	Perform the ID Run again. See Parameter 99.07.
USER MACRO	There is no User Macro saved or the file is defective.	Create the User Macro again.

What to Do in Case of an Earth Fault Indication

This section describes how to trace the cause of an internal earth fault indication (Warning/Fault EARTH FAULT) of the ACA 635.

An earth fault indication does not always indicate an actual earth fault. The indication can sometimes be caused by a faulty IGBT or a faulty NGDR control board.

Flowchart Use this flowchart for tracing the cause of an earth fault indication and for locating faulty parts. The flowchart includes remedies.



Chapter 8 – Parameters

Overview

Parameters for the IGBT supply unit control program are described in the tables below.

Symbols used in the tables:

Column Type: I = integer, R = real, B = boolean, C = character string

ISU = ACA 635 IGBT Supply Unit

1 Actual Signals

Code	Parameter	Range/Unit	Description	Integer Scaling
1	**ACTUAL SIGNALS**			
1.05	FREQUENCY	Hz	Calculated line frequency	100 = 1 Hz
1.06	LINE CURRENT	A	Measured line current	1= 1 A
1.07	REACTIVE POWER	kVAr	Calculated reactive power	1 = 1 kVAr
1.08	POWER	kW	Calculated line converter power	1= 1 kW
1.09	POWER	%	Input power in percentage of nominal value (Par. 4.06 CONV NOM POWER)	1= 1 %
1.10	DC VOLTAGE	V	Measured intermediate circuit voltage	1= 1 V
1.11	MAINS VOLTAGE	V	Calculated input voltage	1= 1 V
1.12	PP TEMP	°C	Temperature of the power plate in degrees Celcius	1 = 1 °C
1.13	TIME OF USAGE	h	Elapsed time meter. The timer is running when the NAMC board is powered.	1 = 1 h
1.14	KWH SUPPLY	kWh	This actual signal counts the kilowatt hours in operation.	1 = 100 kWh
1.15	DI6-1 STATUS	0000000... 0111111	Status of the digital inputs in the software. 0 VDC = “0” +24 VDC = “1” *Example* Control Panel (CDP 312) display when digital inputs 1 and 4 are activated is 0001001, where the digits for digital inputs are read from right to left (DI1 to DI6).	1= 1
1.16	KWH MOTORING	kWh	This actual signal counts the kilowatt hours of motoring (power flow from mains to intermediate circuit).	1 = 100 kWh
1.17	KWH GENERATING	kWh	This actual signal counts the kilowatt hours of regenerative braking (power flow from intermediate circuit to mains).	1 = 100 kWh
1.19	AI1 [V]	0...10	Non-scaled value of analogue input AI1. See Par. 13.0 AI1 HIGH VALUE and 13.02 AI1 LOW VALUE.	10000 = 10 V or 20 mA
1.20	AI2 [mA]	0...20	Non-scaled value of analogue input AI2. See Par. 13.04 AI2 HIGH VALUE and 13.05 AI2 LOW VALUE.	20000 = 20 mA, 2 V or 10 V
1.21	AI3 [mA]	0...20	Non-scaled value of analogue input AI3. See Par. 13.08 AI3 HIGH VALUE and 13.09 AI3 LOW VALUE.	20000 = 20 mA
1.22	RO3-1 STATUS	0000000... 0000111	Status of the standard I/O board relay outputs. *Example* Control Panel (CDP 312) display when relay outputs 2 and 3 are activated is 0000110, where the digits are read from right to left (DO1 to DO6)	1 = 1
1.23	AO1 [mA]	0...20 mA	Value of analogue output 1 signal in milliamperes. For signal selecting and scaling, see Parameter Group 15.	20000 = 20 mA
1.24	AO2 [mA]	0...20 mA	Value of analogue output 2 signal in milliamperes. For signal selecting and scaling, see Parameter Group 15.	20000 = 20 mA
1.26	LED PANEL OUTPUT	%	Monitoring of the NLMD-01 LED panel output. See Parameter Group 18.	1= 1
1.27	COSFII		Calculated cosfii	100 = 1

2 Actual Signals

Code	Parameter	Unit	Description	Integer Scaling
2	**ACTUAL SIGNALS**			
2.05	DC REF Q-CTRL	V	Intermediate circuit voltage reference calculated by reactive power control	1 = 1 V
2.06	DC REF RAMP	V	Ramped and limited intermediate circuit voltage reference for power control	1 = 1 V
2.07	DC REF INITIALIZ	V	Initialized intermediate circuit voltage reference based on line-side ID Run. The voltage reference is calculated from DC voltage measurement and is approximately $\sqrt{2}$ · supply network voltage.	1 = 1 V

3 Actual Signals

Code	Parameter	Unit	Description	Integer Scaling
3	**ACTUAL SIGNALS**		These parameters are visible in parallel connected units (frame sizes 2xR11i/R12i and 4xR11i/R12i) only and show the highest power plate temperatures of the phase module blocks no. 1 to 4 (see *Chapter 3 – Hardware Description*: *IGBT Supply Unit*). LEDs on the NINT board indicate the hottest phase (U, V or W) of each module block. See *Chapter 7 – Fault Tracing* / *What to Do in Case of an Earth Fault Indication*.	
3.12	PP 0 TEMP	°C	The highest power plate temperature of phase module block 1.	1 = 1 °C
3.13	PP 1 TEMP	°C	The highest power plate temperature of phase module block 2.	1 = 1 °C
3.14	PP 2 TEMP	°C	The highest power plate temperature of phase module block 3.	1 = 1 °C
3.15	PP 3 TEMP	°C	The highest power plate temperature of phase module block 4.	1 = 1 °C

4 Information

The software version (Parameters 4.01 and 4.03) is expressed as follows:

Character no	Example	Meaning
1	I	I = Input bridge software
2	M	Product: M= ISU
3	4	Software type: 4 = non-parallel connected ISU (Parameter 4.01) 5 = parallel connected ISU (Parameter 4.01) A = application software (Parameter 4.03)
4	B	Control board: B = NAMC-2x, E = NAMC-11
5 to 8	5060	Software version number

Code	Parameter	Type	Range/Unit	Description	Integer Scaling
4	**INFORMATION**				
4.01	SOFTWARE VERSION	C	IM4x xxxx	This signal describes the software of the downloaded loading package.	
4.02	DTC SW VERSION	C	xxxx	Software version number of the flux software. This fixed part of the software consists of the line converter control, operation system, communication control of the DDCS channels and Modbus software for the control panel.	
4.03	APPLIC SW VERSION	C	IxAx xxxx	The application software name can be identified by means of this signal. This part of the software has been written using PC elements.	
4.04	CONV NOM VOLTAGE	R	V	Downloaded line converter nominal supply voltage	1 = 1 V
4.05	CONV NOM CURRENT	R	A	Downloaded line converter nominal line current	1 = 1 A
4.06	CONV NOM POWER	R	kW	Line converter nominal power.	1 = 1 kW
4.07	CONV MAX VOLTAGE	R	V	Maximum value of converter voltage measuring range	1 = 1 V
4.08	CONV MAX CURRENT	R	A	Maximum value of converter current measuring range	1 = 1 A

7 Control Word

Parameter 7.01 is the control word of the line converter. The control word is a 16-bit packed boolean word displayed as a hex value and updated at 10 ms intervals.

Parameter 7.01 MAIN CTRL WORD (Control word of the line converter)			
Bit	**Name**	**Value**	**Description**
0	ON	0 ⇒ 1	Starts charging
	OFF	0	Opens main contactor
1, 2		0	Not in use
3	START	1	Starts modulation
		0	Stops modulation
4...6		0	Not in use
7	RESET	0 ⇒ 1	Makes a reset
		0	–
8...15		0	Not in use

8 Status Word

This parameter is a 16-bit packed boolean word displayed as a hex value and updated at 4 ms intervals.

Parameter 8.01 MAIN STATUS WORD (Status signals of the line converter)			
Bit	**Name**	**Value**	**STATE/Description**
0	RDY_ON	1	Ready to switch on = no fault
		0	Not ready to switch on = fault
1	RDY_RUN	1	Ready to operate = DC bus charged
		0	Not ready to operate
2	RDY_REF	1	Operation enabled
		0	
3	TRIPPED	1	Fault
		0	No fault
4, 5, 6		–	Not in use
7	ALARM	1	Warning
		0	No Warning
8	MODULATING	1	Line converter modulates.
		0	Line converter not modulating
9	REMOTE	1	Drive control location: REMOTE
		0	Drive control location: LOCAL
10	NET OK	1	Network voltage is OK.
		0	Network voltage is lost.
11		–	Not in use
12, 13		–	Not in use
14	CHARGING	1	Charging contactor closed
		0	Charging contactor open
15		–	Not in use

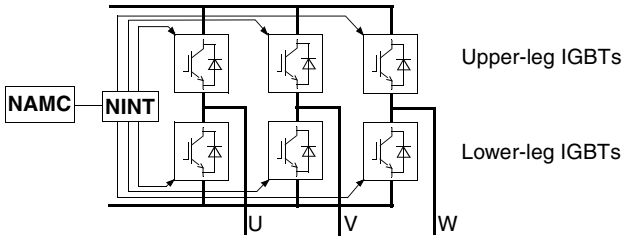
9 Fault Words

These parameters are 16-bit words. They are displayed as hex values. Bit value 1 = Fault, and 0 = No Fault. Parameters are updated at 100 ms intervals.

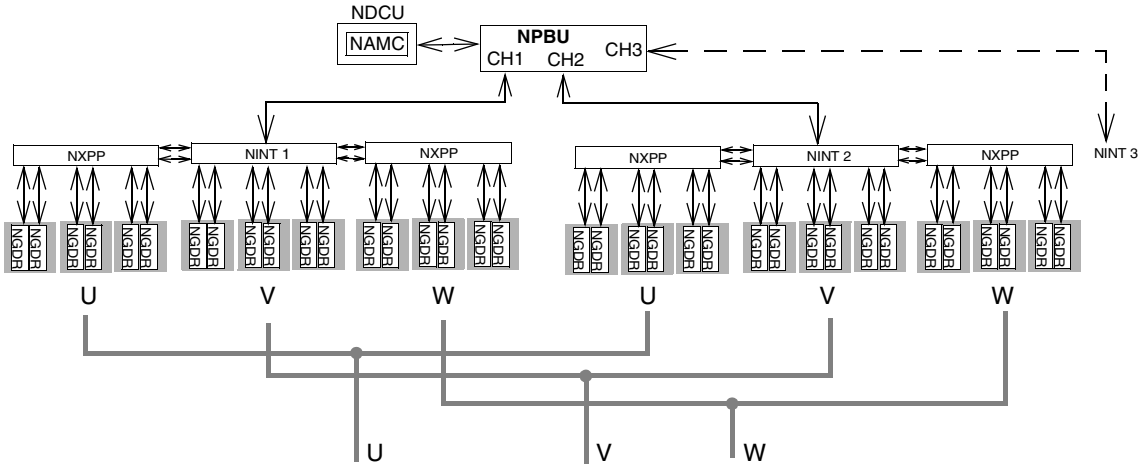
Code	Parameter	Bit	Name	Description
9	**FAULT WORDS**			
9.01	FAULT WORD 1			
		0	SHORT CIRC	Short-circuit in the main circuit
		1	OVERCURRENT	Overcurrent
		2	DC OVERVOLT	Intermediate circuit DC overvoltage
		3	ACS 600 TEMP	Power plate overtemperature
		4	EARTH FAULT	Internally detected earth fault
		5, 6		Not in use
		7		Internal faults. If this bit is 1 write down the value of Parameter 9.03. Contact ABB.
		8...11		Not in use
		12	SC (INU1)	Short-circuit in parallel connected phase module block 1
		13	SC (INU2)	Short-circuit in parallel connected phase module block 2
		14	SC (INU3)	Short-circuit in parallel connected phase module block 3
		15	SC (INU4)	Short-circuit in parallel connected phase module block 4
9.02	FAULT WORD 2			
		0	SUPPLY PHASE	Missing phase during synchronisation
		1		Not in use
		2	DC UNDERVOLT	Intermediate circuit DC undervoltage
		3...5		Not in use
		6	IO FAULT	I/O device fault on CH1
		7	AMBIENT TEMP	I/O control board (NIOC) temperature
		8		Not in use
		9	OVER SWFREQ	Switching overfrequency
		10		Not in use
		11	PPCC LINK	Current measurement or communication fault of NINT board
		12	CH0 COM LOST	Communication break on CH0
		13...15		Not in use
9.03	FAULT WORD 3			
		0	FLT (F1_7)	Factory default parameter file error
		1	USER MACRO	User Macro file error
		2	FLT (F1_4)	EPROM operating error
		3	FLT (F1_5)	FPROM data error
		4	FLT (F2_12)	Internal time level 2 overflow (100 μs)
		5	FLT (F2_13)	Internal time level 3 overflow (1 ms)
		6	FLT (F2_14)	Internal time level 4 overflow (50 ms)
		7	FLT (F2_15)	Internal time level 5 overflow (1 s)
		8	FLT (F2_16)	State machine overflow
		9	FLT (F2_17)	Application program execution error
		10	FLT (F2_18)	Application program execution error
		11	FLT (F2_19)	Illegal instruction
		12	FLT (F2_3)	Register stack overflow
		13	FLT (F2_1)	System stack overflow
		14	FLT (F2_0)	System stack underflow
		15		Reserved

Code	Parameter	Bit	Name	Description
9	**FAULT WORDS**			
9.07	INT FAULT INFO			* Bits 0 to 3 are in use with parallel-connected converters only. Control board NINT 1 (of phase module block 1) is connected to branching unit board NPBU channel CH1, NINT 2 is connected to channel CH2 etc.
		0	NINT 1 FAULT	NINT 1 board fault *
		1	NINT 2 FAULT	NINT 2 board fault *
		2	NINT 3 FAULT	NINT 3 board fault *
		3	NINT 4 FAULT	NINT 4 board fault *
		4	NPBU FAULT	NPBU board fault *
		5		Not in use
		6	U-PH SC U	Short-circuit in phase U upper-leg IGBT(s)
		7	U-PH SC L	Short-circuit in phase U lower-leg IGBT(s)
		8	V-PH SC U	Short-circuit in phase V upper-leg IGBT(s)
		9	V-PH SC L	Short-circuit in phase V lower-leg IGBT(s)
		10	W-PH SC U	Short-circuit in phase W upper-leg IGBT(s)
		11	W-PH SC L	Short-circuit in phase W lower-leg IGBT(s)
		12...15		Not in use

Converter Phase Module Block



Converter Constructed of Two to Four Parallel-connected Phase Module Blocks



Code	Parameter	Bit	Name	Description
9	**FAULT WORDS**			
9.11	SUPPLY FAULT WORD			
		0	CHARGING FLT	DC link short-circuit during charging
		1	OVERCURRENT	Overcurrent
		2	DI5 = 0	External fault indicated via DI5
		3	ACS 600 TEMP	Power plate overtemperature
		4	E EARTH FLT	Earth fault detected by an external monitoring device
		5	FAN FLT	Fan failure. Fault is activated 5 seconds after failure.
		6	MAIN CNT FLT	Main contactor failure
		7	SHORT CIRC	Short-circuit in the main circuit (indication from power plate).
		8		Internal faults. If this bit is 1 write down the value of Parameter 9.03. Contact ABB.
		9	NET VOLT FLT	Supply voltage out of range during synchronisation
		10	CH0 COM LOST	Communication break on CH0
		11		Not in use
		12	EARTH FAULT	Internally detected earth fault
		13	SYNCHRO FLT	Synchronisation to supply failed
		14	DC UNDERVOLT	Intermediate circuit DC undervoltage
		15	DC OVERVOLT	Intermediate circuit DC overvoltage
9.12	SUPPLY ALARM WORD			
		0	CH0 TIMEOUT	Communication break detected
		1	PANEL LOST	Local control lost
		2		Not in use
		3	AI<MIN FUNC	Current below 4 mA (4 mA minimum selected)
		4	ACS 600 TEMP	ACS 600 internal temperature excessive
		5	CURRENT LIM	Current limit exceeded
		6...9		Not in use
		10	NET LOST	Network voltage lost
		11, 12		Not in use
		13	EARTH FAULT	Internally detected earth fault
			E EARTH FLT	Earth fault detected by an external monitoring device
		14	DI5 = 0	External fault indicated via DI5
		15		Not in use

11 Reference Selects

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description	Integer Scaling
11	**REFERENCE SELECT**					
11.01	DC REF SELECT	I	PARAM 23.1	**(1)** PARAM 23.1; **(2)** AI1; **(3)** AI2; **(4)** AI3	Source for intermediate circuit DC voltage reference	1 = 1
11.02	Q REF SELECT	I	PARAM 24.1	**(1)** PARAM 24.1; **(2)** AI1; **(3)** AI2; **(4)** AI3	Source for reactive power reference	1 = 1

13 Analogue Inputs

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description	Integer Scaling
13	**ANALOGUE INPUTS**					
13.01	AI1 HIGH VALUE	I	20000	-32768...32767	This value corresponds to the maximum input voltage on analogue input AI1.	1 = 1
13.02	AI1 LOW VALUE	I	0	-32768...32767	This value corresponds to the minimum input voltage on analogue input AI1.	1 = 1
13.03	FILTER AI1	R	1000	0...30000 ms	Filter time constant for analogue input AI1. The hardware filter time constant is 20 ms.	1 = 1 ms
13.04	AI2 HIGH VALUE	I	0	-32768...32767	This value corresponds to the maximum input in milliamperes (20 mA) on analogue input AI2.	1 = 1
13.05	AI2 LOW VALUE	I	0	-32768...32767	This value corresponds to the minimum input in milliamperes (0 or 4 mA) on analogue input AI2.	1 = 1
13.06	MINIMUM AI2	I	0 mA	**(1)** 0 mA; **(2)** 4 mA	This value corresponds to the minimum reference from analogue input AI2.	
13.07	FILTER AI2	R	1000 ms	0...30000 ms	Filter time constant for analogue input AI2. The hardware filter time constant is 20 ms.	1 = 1 ms
13.08	AI3 HIGH VALUE	I	10000	-32768...32767	This value corresponds to the maximum input in milliamperes (20 mA) on analogue input AI3.	1 = 1
13.09	AI3 LOW VALUE	I	0	-32768...32767	This value corresponds to the minimum input in milliamperes (0 or 4 mA) on analogue input AI3.	1 = 1
13.10	MINIMUM AI3	I	0 mA	**(1)** 0 mA; **(2)** 4 mA	This value corresponds to the minimum reference from analogue input AI3.	
13.11	FILTER AI3	R	1000 ms	0...30000 ms	Filter time constant for analogue input AI3. The hardware filter time constant is 20 ms.	1 = 1 ms

14 Digital Outputs

Code	Parameter	Type	Default	Range	Description	Integer Scaling
14	**DIGITAL OUTPUTS**					
14.04	DO2 GROUP+INDEX		801	-199999...+199999	This parameter selects the signal that controls digital output D02 by the bit specified with Par. 14.05 DO2 BIT NUMBER. Example: When bit number 0 (RDY_ON) of Par 8.01 MAIN STATUS WORD is selected to digital output D02, the value of Par. 14.04 is set to 801, where 8 indicates the group and 01 the index of the selected signal. The bit number is specified with Par. 14.05 DO2 BIT NUMBER. ***Note***: Invertation of the output is set with a minus sign of the Par. 14.04 value.	1 = 1
14.05	DO2 BIT NUMBER		0	0...15	This parameter specifies the bit number of the signal selected with Par. 14.04 DO2 GROUP+ INDEX. See the example above.	1 = 1

15 Analogue Outputs

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description	Integer Scaling
15	**ANALOGUE OUTPUTS**					
15.01	ANALOGUE OUTPUT 1	I	106	0...30000	Analogue output signal 1 source selection. Example: To link Par. 23. 01 DC VOLT REF to analogue output 1, set Parameter 15.01 to value 2301.	1 = 1
15.02	INVERT AO1	B	NO	**(0)** NO; **(1)** YES	Analogue output signal 1 inversion	
15.03	MINIMUM AO1	I	0 mA	**(1)** 0 mA; **(2)** 4 mA; **(3)** 10 mA	Analogue output signal 1 offset in milliamperes	
15.04	FILTER AO1	R	0.10 s	0...10 s	Filter time constant for AO1	100 = 1 s
15.05	SCALE AO1	R	100	0...65536	Nominal value of AO1 (Par. 15.01 ANALOGUE OUTPUT 1). It corresponds to 20 mA at the output. Example: Par. 1.06 LINE CURRENT is linked to Parameter 15.01 ANALOGUE OUTPUT 1. The value of Par. 15.05 is 100. When the value of Par. 1.06 LINE CURRENT is 100 A, the output of AO1 is 20 mA.	1 = 1
15.06	ANALOGUE OUTPUT 2	I	101	0...30000	Analogue output signal 2 source selection. See example in Par. 15.01.	1 = 1
15.07	INVERT AO2	B	NO	**(0)** NO; **(1)** YES	Analogue output signal 2 inversion	
15.08	MINIMUM AO2	I	0 mA	**(1)** 0 mA; **(2)** 4 mA **(3)** 10 mA	Analogue output signal 2 offset in milliamperes	
15.09	FILTER AO2	R	0.10 s	0...10 s	Filter time constant for AO2	100 = 1 s
15.10	SCALE AO2	R	3000	0...65536	Nominal value of AO2 signal (Par. 15.06 ANALOGUE OUTPUT 2). It corresponds to 20 mA at the output. See example in Par. 15.05.	1 = 1

16 System Control Inputs

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description
16	**SYSTEM CTR INPUTS**				
16.02	PARAMETER LOCK	B	OPEN		With this parameter unauthorised parameter changes by CDP 312 Control Panel or the Drive*Window* PC tool can be inhibited for Parameter Groups 0...99.
				(1) LOCKED	Parameter changes are disabled.
				(0) OPEN	Parameter changes are enabled.
16.03	PASS CODE	I	0		Pass code for the Parameter Lock. The default value is 0. To open the Parameter Lock for parameter groups below 100, change the value to 358. After the Parameter Lock is opened, the value is automatically reset.
16.06	PARAMETER BACKUP	I	DONE		
				(0) DONE	Parameter value after the saving has been completed
				(1) SAVE	Parameter saving from RAM to permanent FPROM memory. ***Note:*** Parameter changes done through the CDP 312 Control Panel or *DriveWindow* are saved automatically to FPROM. Parameter changes done by an overriding control system (e.g. fieldbus or AC 80) via CH0 of the NAMC board are saved only to the volatile RAM memory. The changes need to be saved to FPROM separately using this parameter selection.

18 LED Panel Control

Code	Parameter	Type	Default	Range	Description	Integer Scaling
18	**LED PANEL CTRL**				The NLMD-01 Monitoring Display has a LED bar to show an absolute real type value: 0 50 100 150 % [ ] . The source and the scale of the display signal are defined by this parameter group. ***Note:*** If NLMD -01 and CDP 312 Control Panel are used together, Actual Signal 1.26 LED PANEL OUTPUT must be the first signal in CDP 312 Actual Signal Display Mode. Otherwise the NLMD-01 LED bar display will show an incorrect value.	
18.01	LED PANEL OUTPUT	I	109	0...30000	Signal source selection for the NLMD-01 Monitoring Display. Example: To link Par. 1.09 POWER to the display set Parameter 18.01 to value 109.	1 = 1
18.02	SCALE PANEL	R	100	0...65536	Scaling factor for the NLMD-01 Monitoring Display. Example: Par. 1.05 FREQUENCY is linked to Parameter 18.01. The frequency is 50 Hz (= 100 • 50 = 5000 as integer scaled). Value 5000 of Parameter 18.02 gives 100% display on the NLMD-01.	1 = 1

19 Data Storage

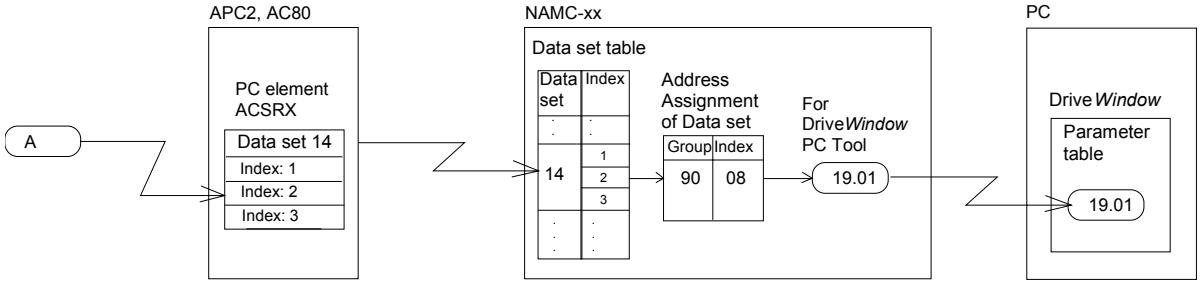
Parameters of this group are storages for receiving information from or sending it to an overriding system. The parameters are unconnected. They can be used for linking, testing and commissioning purposes.

Trend Monitoring with Drive Window

Example 1.

Address of data set 14 index 2 is 90.08. For monitoring a signal assigned for drive control from data set 14 index 2 (data word 14.2) by Drive*Window* follow the steps below.

3. Set Parameter 90.08 D SET 14 VAL 2 to 1901 (denoting Parameter 19.01).
4. Set Drive*Window* monitoring channel to read Parameter 19.01.

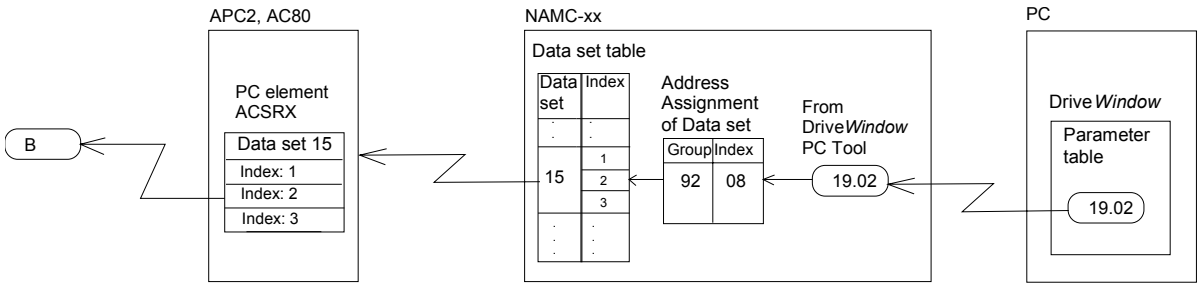


A = a value assigned from overriding system to drive control

Sending a value

Example 1.

To send a value to overriding system data set 15 index 2, set Parameter 92.08 D SET 15 VAL 2 to 1902 by a CDP 312 Control Panel or Drive*Window*.



B = a value assigned for overriding system application

19 Data Storage Parameter Table

Integer scaling of these parameters is 1 = 1, the type is real and the range is -32768...+32767.

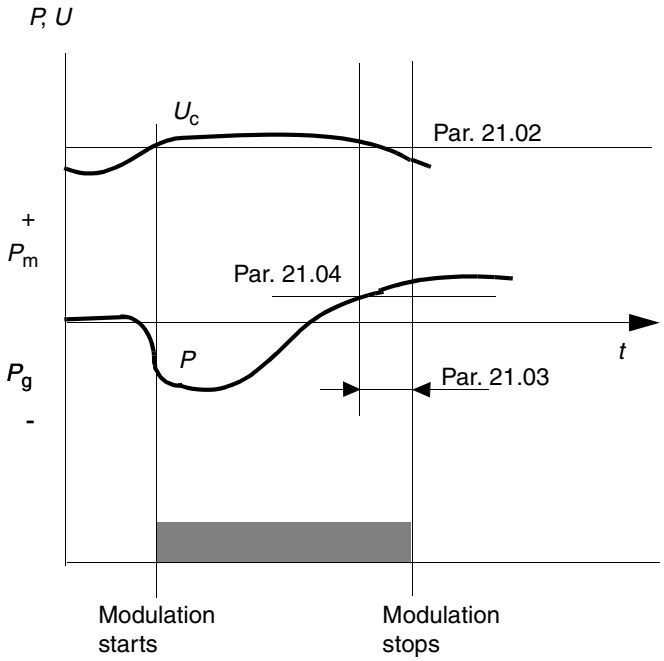
Code	Parameter
19	**DATA STORAGE**
19.01	DATA 1
19.02	DATA 2
19.03	DATA 3
19.04	DATA 4
19.05	DATA 5
19.06	DATA 6
19.07	DATA 7
19.08	DATA 8

21 Start/Stop Functions

Code	Parameter	Type	Default	Range/Unit	Description
21	**START/STOP**				
21.01	DC LEVEL START	B	NO	**(0)** NO	Disable level start
				(1) YES	Enable level start. ***Note:*** If Par. 99.08 AUTO LINE ID RUN is set to YES, the ACA 635 performs the ID Run in NAMC board power-up and modulates for one second thereafter. The ACA 635 stops and waits until DC voltage exceeds the level of Par. 21.02 DC VOLTAGE LEVEL.
21.02	DC VOLTAGE LEVEL	R	See table below.	See table below.	Intermediate circuit DC voltage level at which the modulation starts
21.03	STOP LEVEL TIME	R	1000 ms	ms	Modulator is stopped when the power is higher than defined with Par. 21.04 STOP LEVEL POWER for a time defined with this parameter.
21.04	STOP LEVEL POWER	R	0 kW	kW	Motoring power to stop the modulator

Par. 4.04 CONV NOM VOLTAGE	**Default of Par. 21.02:** 1.1 · √2 · Par. 4.04 CONV NOM VOLTAGE	**Range of Par. 21.02:** (65% ...120%) · √2 · Par. 4.04 CONV NOM VOLTAGE	
(V)	(V)	Minimum (V)	Maximum (V)
415	646	380	706
500	778	457	851
690	1073	632	1174

The functions set by this parameter group are visualised below. U_c is intermediate circuit DC voltage. *P* is converter supply power.



23 DC Bus Reference

With the help of the Parameter 23.01 DC VOLT REF, the DC link voltage can be raised higher than with a conventional 6-pulse diode rectifier in order to compensate a low voltage level in the network.

Note: Check the motor insulation requirement. See *ACS 600 MultiDrive Safety and Product Information* guide, EN code 63982229, or ACS/ACC 6x7 Hardware Manual, EN code 61329005.

Example If the line voltage is 380 V, fully loaded DC voltage with 6-pulse diode rectifier is 1.35 · 380 V = 513 V. If the desired motor rms level is 400 V with sinusoidal voltage (peak value = $\sqrt{2}$ · 400 V = 565 V), the voltage drop can be compensated simply by setting Parameter 23.01 DC VOLT REF to value 565. However, the input current to produce the output power is still calculated on the basis of 380 V: P = $\sqrt{3}$ · 380 · line current.

Code	Parameter	Type	Range	Description	Integer Scaling
23	**DC VOLT REF**				
23.01	DC VOLT REF	R	See table below.	User-given setpoint value for intermediate circuit DC voltage reference	1 = 1 V

Par. 4.04 CONV NOM VOLTAGE (V)	Range of Par. 23.01: (65% ...120%) · $\sqrt{2}$ · Par. 4.04 CONV NOM VOLTAGE	
	Minimum (V)	Maximum (V)
415	380	706
500	457	851
690	632	1174

24 Reactive Power

Code	Parameter	Type	Default	Range	Description	Integer Scaling
24	**REACTIVE POWER**					
24.01	Q POWER REF	R	0%	-100%...+100%	Setpoint value for reactive power control in percentage of Par. 4.06 CONV NOM POWER. Reactive power control is capable of generating the set amount of reactive power to the network (positive = capacitive, negative = reactive).	1 = 1 %

30 Fault Functions

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description	Integer Scaling
30	**FAULT FUNCTIONS**					1 = 1
30.02	EARTH FAULT	B	WARNING	**(0)** WARNING	A warning is given in an earth fault condition.	1 = 1
				(1) FAULT	Converter trips in an earth fault.	1 = 1
30.03	EARTH FAULT LEVEL	R	4		Non-parallel connected conveters (frame sizes R8i, R9i, R10i, R11i and R12i): This parameter sets the earth fault trip level through the PPCC link. Parallel connected converters (frame sizes 2xR11i, 2xR12i, 4xR11i, 4xR12i): current unbalance protection of converter output, e.g, in a short-circuit.	1 = 1
				1	1 % unbalance in the sum current	
				2	3 % unbalance in the sum current	
				3	8 % unbalance in the sum current	
				4	13 % unbalance in the sum current	
				5	18 % unbalance in the sum current	
				6	28 % unbalance in the sum current	
				7	39 % unbalance in the sum current	
				8	62 % unbalance in the sum current	
30.04	EXT EARTH FAULT	I	NO		Earth fault detector is connected to digital input DI4. This parameter selects the converter reaction.	1 = 1
				(1) NO	Not in use	
				(2) DI4=0 FAULTS	Converter trips on EARTH FAULT if DI4 is OFF (0).	
				(3) DI4=1 FAULTS	Converter trips on EARTH FAULT if DI4 is ON (1).	
				(4) DI4=0 ALARMS	A warning is given if DI4 is OFF (0).	
				(5) DI4=1 ALARMS	A warning is given if DI4 is ON (1).	
30.05	EXT EVENT	I	NO		This parameter selects the converter reaction to the state of digital input DI5.	
				(1) NO	Not in use	
				(2) DI5=0 ALARMS	A warning is given if DI5 is OFF (0).	
				(3) DI5=0 FAULTS	Converter trips if DI5 is OFF (0).	
30.11	DC OVERVOLT TRIP	R	740/891/1230	0...747 VDC (415 V units) 0...900 VDC (500 V units) 0...1242 V DC (690 V units)	Intermediate circuit DC overvoltage trip limit. The lower range limit is determined by Par. 30.12 DC UNDERVOLT TRIP. When the setting of this parameter is changed, the corresponding higher range limit of Par. 30.12 DC OVERVOLT TRIP will also change.	1 = 1

30.12	DC UNDERVOLT TRIP	R	293/354/488	0...747 VDC (415 V units) 0...900 VDC (500 V units) 0...1242 V DC (690 V units)	Intermediate circuit DC undervoltage trip limit. The higher range limit is determined by Par. 30.11 DC OVERVOLT TRIP. When the setting of this parameter is changed, the corresponding lower range limit of Par. 30.11 DC OVERVOLT TRIP will also change. This parameter also determines DC voltage check limit during charging.	1 = 1

51 Communication Module

Code	Parameter	Type	Description
51	**COMMUNICATION MODULE**		This group defines the communication parameters for a fieldbus adapter module. The parameter names are copied from the module when it is installed and its connection to the drive is activated with Parameter 98.02 COMM MODULE. See the module manual.
51.01	FIELDBUS PAR1	C	Module type and software version
51.02 ... 51.15	FIELDBUS_PAR2 ...15	R	According to module type

70 DDCS Control

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description	Integer Scaling
70	**DDCS CONTROL**					
70.01	CH0 NODE ADDR	R	1	1...125	Node address for channel CH0. When using the AC 80 system, the address must be 1. In other control systems, node address is set according to the application.	1 = 1
70.02	CH0 LINK CONTROL	R	10	1...15	DDCS channel CH0 intensity control for transmission LEDs. This parameter can be used in special cases to optimise the communication performance in the link.	1= 1
70.03	CH0 BAUD RATE	I	4 Mbit/s	**(0)** 8 Mbit/s (not in use); **(1)** 4 Mbit/s; **(2)** 2 Mbit/s (not in use); **(3)** 1 Mbit/s	Channel CH0 communication speed. This parameter must be set to 4 Mbits/s, when FCI communication module is used. Otherwise overriding system automatically sets the communication speed.	
70.04	CH0 TIMEOUT	R	100 ms	0...60000 ms	The delay time before a communication break fault is indicated. The time count starts when the link does not update the message. During the time elapsing, CH0 TIMEOUT warning is set by 9.12 SUPPLY ALARM WORD bit 0. When the value of Par. 70.04 is zero, timeout is not monitored and CH0 COM LOST fault is not indicated regardless of the value of Par. 70.05.	1 = 1 ms

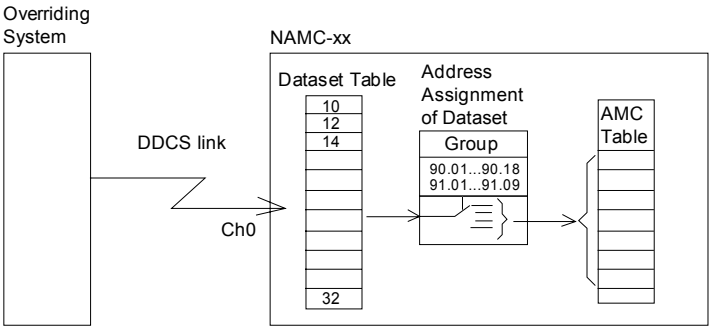
70.05	CH0 COMM LOSS CTRL	I	FAULT		This parameter is in use when Par. 98.01 COMMAND SEL is set to MCW and Par. 98.02 COMM MODULE to FBA DSET1, FBA DSET10 or INVERTER.	
				(1) NO FAULT	A warning is given on communication loss on channel CH0.	
				(2) FAULT	Converter trips on communication loss on channel CH0.	
70.06	CH1 LINK CONTROL	R	10	1...15	DDCS channel CH1 intensity control for transmission LEDs. This value is adjusted through the link including each device in the link. This parameter can be used in special cases to optimise the communication performance in the link.	1 = 1
70.15	CH3 NODE ADDR	R	1	1...254	Node address for the channel CH3. This channel is normally used with the start-up and maintenance tools. If CH3 of the several drives have been connected to the ring or star (by branching unit) connection, each one must be set an unique node address. The new node address becomes valid only after auxiliary power shutdown of the NAMC board.	1 = 1
70.16	CH3 LINK CONTROL	R	15	1...15	DDCS channel CH3 intensity control for transmission LEDs. This value is adjusted through the link including each device in the link. This parameter can be used in special cases to optimise the communication performance in the link.	1=1
70.19	CH0 HW CONNECTION	B	STAR		This parameter is used for enabling or disabling regeneration of channel CH0 optical transmitter in DDCS mode. DDCS mode is typically used with APC2, AC70 and AC450 controllers. In regeneration mode any message received by the channel is echoed back. This parameter is not in use in DriveBus mode.	1=1
				(0) RING	Regeneration enabled. Select RING if the CH0 channels on the NAMC boards are connected to a ring configuration.	
				(1) STAR	Regeneration disabled. Select STAR with a star configuration as AC450 – CI810 – NDBU-95 optical branching unit(s) – ACS 600.	
70.20	CH3 HW CONNECTION	B	STAR		This parameter is used for enabling or disabling regeneration of channel CH3 optical transmitter. In regeneration mode any message received by the channel is echoed back.	1=1
				(0) RING	Regeneration enabled. Select RING if the CH3 channels on the NAMC boards are connected to a ring configuration.	
				(1) STAR	Regeneration disabled. Select STAR with a star configuration as Drive*Window* (PC) – NDBU-95 optical branching unit(s) – ACS 600.	

71 DriveBus Communication

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description	Integer Scaling
71	**DRIVEBUS COMM**					
70.01	CH0 DRIVEBUS MODE	B	YES		This parameters selects the communication mode for channel CH0 on the NAMC board.The new mode becomes valid only on the next NAMC board power-on.	1 = 1
				(0) NO	DDCS mode	
				(1) YES	DriveBus mode with AC 80 controller	

90, 91 Data Set Receive Addresses

Parameters of this group are addresses for received data from the overiding system. Integer scaling of the parameters is 1 = 1 and range 0...9999.

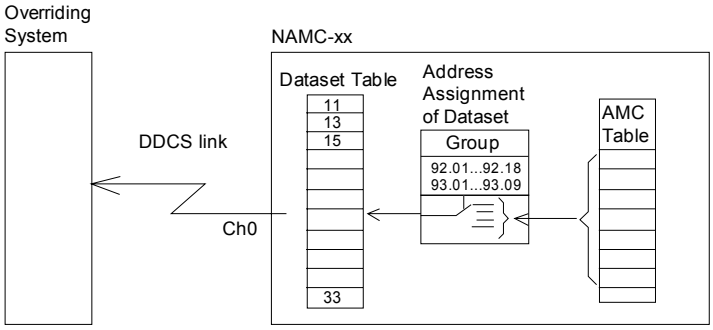


Parameter description in the table below: Data set xx value x (e.g. data set 10 value 1) receive address.

Code	Parameter	Default	Updating Interval (ms)
90, 91	**DATA SET RECEIVE ADDRESSES**		
90.01	D SET 10 VAL 1	701	4
90.02	D SET 10 VAL 2	0	4
90.03	D SET 10 VAL 3	0	4
90.04	D SET 12 VAL 1	0	4
90.05	D SET 12 VAL 2	0	4
90.06	D SET 12 VAL 3	0	4
90.07	D SET 14 VAL 1	0	100
90.08	D SET 14 VAL 2	0	100
90.09	D SET 14 VAL 3	0	100
90.10	D SET 16 VAL 1	0	100
90.11	D SET 16 VAL 2	0	100
90.12	D SET 16 VAL 3	0	100
90.13	D SET 18 VAL 1	0	100
90.14	D SET 18 VAL 2	0	100
90.15	D SET 18 VAL 3	0	100
90.16	D SET 20 VAL 1	0	100
90.17	D SET 20 VAL 2	0	100
90.18	D SET 20 VAL 3	0	100
91.01	D SET 22 VAL 1	0	100
91.02	D SET 22 VAL 2	0	100
91.03	D SET 22 VAL 3	0	100
91.04	D SET 24 VAL 1	0	500
91.05	D SET 24 VAL 2	0	500
91.06	D SET 24 VAL 3	0	500
91.07	D SET 32 VAL 1	0	1000
91.08	D SET 32 VAL 2	0	1000
91.09	D SET 32 VAL 3	0	1000

92, 93 Data Set Transmit Addresses

Parameters of this group are signal addresses for transmitted data to the overiding system. Integer scaling of the parameters is 1 = 1 and range 0...9999.



Parameter description in the table below: Data set xx value x (e.g. data set 11 value 1) transmit address.

Code	Parameter	Default	Updating Interval (ms) / Description
92, 93	**DATA SET TRANSMIT ADDRESSES**		
92.01	D SET 11 VAL 1	801	4
92.02	D SET 11 VAL 2	110	4
92.03	D SET 11 VAL 3	0	4
92.04	D SET 13 VAL 1	0	100
92.05	D SET 13 VAL 2	111	100
92.06	D SET 13 VAL 3	106	100
92.07	D SET 15 VAL 1	911	100
92.08	D SET 15 VAL 2	0	100
92.09	D SET 15 VAL 3	0	100
92.10	D SET 17 VAL 1	912	100
92.11	D SET 17 VAL 2	115	100
92.12	D SET 17 VAL 3	122	100
92.13	D SET 19 VAL 1	0	500
92.14	D SET 19 VAL 2	0	500
92.15	D SET 19 VAL 3	0	500
92.16	D SET 21 VAL 1	108	500
92.17	D SET 21 VAL 2	112	500
92.18	D SET 21 VAL 3	0	500
93.01	D SET 23 VAL 1	0	500
93.02	D SET 23 VAL 2	0	500
93.03	D SET 23 VAL 3	0	500
93.04	D SET 25 VAL 1	0	500
93.05	D SET 25 VAL 2	0	500
93.06	D SET 25 VAL 3	0	500
93.07	D SET 33 VAL 1	0	Data set 33 value 1, address feedback for 91.07 D SET 32 VAL 1 (100 ms interval)
93.08	D SET 33 VAL 2	0	Data set 33 value 2 inquire data (100 ms interval)
93.09	D SET 33 VAL 3	0	Data set 33 value 3 inquire address feedback (100 ms interval)

98 Option Modules

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description
98	**OPTION MODULES**				
98.01	COMMAND SEL	B	I/O		This parameter selects the control command interface(s).
				(0) MCW	The ISU control program reads the control commands via a serial link and through the digital input terminals.
				(1) I/O	The ISU control program reads the control commands through the digital input terminals.
98.02	COMM MODULE	I	NO		This parameter defines the control mode and place in the REMOTE mode.
				(1) NO	The drive is controlled using I/O: DI2
				(2) FBA DSET1	The drive is controlled through the communication link (CH0) using datasets 1 and 2. This is a typical setting for use with a fieldbus adapter module.
				(3) FBA DSET10	The drive is controlled through the communication link (CH0) using datasets 10 to 33. (for example APC2, AC 70, AC80, NPBA-02, NCSA-01)
				(4) INVERTER	Not in use

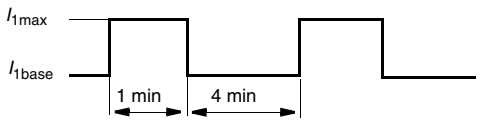
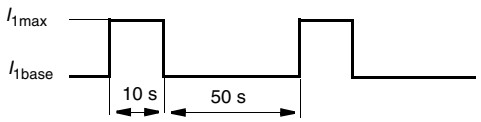
99 Start-up Data

Code	Parameter	Type	Default	Alternative Settings ( ) Fieldbus Equivalent	Description
99	**START UP DATA**				
99.01	LANGUAGE	I	ENGLISH	**(0)** ENGLISH **(1)** ENGLISHAM **(2)** DEUTSCH **(3)** ITALIANO **(4)** ESPAÑOL **(5)** PORTUGUÊS **(6)** NEDERLANS **(7)** FRANÇAIS **(8)** DANSK **(9)** SUOMI **(10)** SVENSKA	The line converter displays the information in the selected language. ***Note:*** only English is available at the time of publishing.
99.02	DEVICE NAME	C		Max. 32 characters	The name of the supply section can be typed here by Drive*Window*. The name is shown in the System Configuration display of Drive*Window*.
99.06	FAST SYNC	B	YES	**(0)** NO	Synchronization with phase order check (two synchronization pulse)
				(1) YES	Synchronization without phase order check (one synchronization pulses)
99.07	LINE SIDE ID RUN	B	NO	**(0)** NO	Line-side converter ID Run is not performed after next start.
				(1) YES	Next start makes line-side converter ID Run. It takes about 5 seconds. After ID Run converter keeps on modulating. It is not allowed to load the motor during the ID Run.
99.08	AUTO LINE ID RUN	B	YES	**(0)** NO	No automatic line-side converter ID Run after power-up
				(1) YES	Line-side converter ID Run is performed automatically after power-up and start.
99.09	APPLIC RESTORE	B	NO	**(0)** NO	
99.10	SUPPLY ID NUMBER	I	0	0...32767	This parameter can be used by the overriding system to check the right connections of the optical cables to the drive type. This parameter requires support from the overriding system to verify the correct connection.

Appendix A – Technical Data

Ratings

Abbreviations This table explains the abbreviations used in the following rating table.

Supply Section	
I_{1N}	Total rms input current (continuous a.c. current)
Duty Cycle (1 min / 5 min)	
I_{1base}	Maximum base current with I_{1max}.
I_{1max}	Short term rms overload a.c. current (allowed for one minute every 5 minutes).
	
Duty Cycle (10 s / 60 s)	
I_{1base}	Maximum base current with I_{1max}.
I_{1max}	Short term rms overload a.c. current (allowed for 10 seconds every 60 seconds)
	
S_N	Rated apparent supply power of the supply section
P_{2N}	Nominal power of intermediate d.c. link (continuous active motor or generator power)
P_{loss}	Power loss
U_N	Nominal mains voltage

Notes ***Note 1:*** The ratings given correspond to voltage U_N and fan supply voltage 230 V or 115 V.

Note 2: P_{loss} is the heat loss of a unit with basic options. The value depends on the options included.

Note 3: Noise level applies to echoless room.

Ratings 380...690 V This table shows the nominal ratings for the IGBT supply sections.

Type Marking	Nominal Ratings			Duty Cycle (1 min / 5 min)		Duty Cycle (10 s / 60 s)		Frame Size	Air Flow	P_{loss}	Noise Level
	S_N	I_{1N}	P_{2N}	I_{1base}	I_{1max}	I_{1base}	I_{1max}				
	kVA	A	kW	A	A	A	A		m^3/h	kW	dBA
IGBT supply sections (380...415 V Range, U_N = 415 V)											
ACA 635-0265-3	260	379	254	284	426	260	520	R8i	2300	7.8	62
ACA 635-0405-3	400	576	386	432	684	395	790	R9i	2300	12.0	62
ACA 635-0500-3	500	720	482	540	810	494	988	R10i	4650	15.0	67
ACA 635-0765-3	697	1006	673	755	1132	691	1384	R11i	4650	20.9	67
ACA 635-1125-3	1035	1494	1000	1121	1681	1036	2072	R12i	6200	31.1	70
ACA 635-1440-3	1325	1913	1280	1434	2152	1381	2762	2xR11i	9300	39.8	70
ACA 635-2145-3	1966	2838	1900	2129	3193	2072	4144	2xR12i	12400	59.0	72
ACA 635-2820-3	2594	3744	2506	2809	4212	2762	5524	4xR11i	18600	77.8	73
IBGT supply sections (380...500 V Range, U_N = 500 V)											
ACA 635-0325-5	320	368	308	276	414	240	480	R8i	2300	9.6	62
ACA 635-0495-5	490	565	473	424	636	365	730	R9i	2300	14.7	62
ACA 635-0610-5	610	700	586	525	788	456	912	R10i	4650	18.3	67
ACA 635-0935-5	855	987	826	741	1111	638	1277	R11i	4650	25.7	67
ACA 635-1385-5	1270	1466	1227	1099	1649	957	1914	R12i	6200	38.1	70
ACA 635-1760-5	1625	1876	1570	1407	2110	1276	2552	2xR11i	9300	48.8	70
ACA 635-2625-5	2411	2784	2329	2088	3133	1915	3829	2xR12i	12400	72.3	72
ACA 635-3450-5	3181	3673	3073	2754	4132	2552	5104	4xR11i	18600	95.4	73
IGBT supply sections (525...690 V Range, U_N = 690 V)											
ACA 635-0315-6	310	264	305	198	297	179	358	R8i	2300	9.3	62
ACA 635-0485-6	490	410	473	308	461	265	530	R9i	2300	14.7	62
ACA 635-0600-6	600	502	580	377	565	340	680	R10i	4650	18.0	67
ACA 635-0900-6	831	695	802	521	781	464	927	R11i	4650	24.9	67
ACA 635-1385-6	1271	1064	1229	798	1196	695	1389	R12i	6200	38.1	70
ACA 635-1710-6	1578	1320	1524	990	1485	926	1853	2xR11i	9300	47.3	70
ACA 635-2545-6	2341	1959	2262	1469	2204	1390	2780	2xR12i	12400	70.2	72
ACA 635-3350-6	3088	2584	2984	1938	2907	1853	3706	4xR11i	18600	92.6	73
ACA 635-5140-6	4728	3956	4568	2967	4451	2778	5557	4xR12i	24800	141.8	73

PDM code 00012716 -A

Dimensions and Weights

This table shows the dimensions and weights of the IGBT supply sections. The weights are estimates and apply to units with basic options and aluminium DC busbars. The width and weight of the auxiliary control unit are included: 400 mm (for frame sizes R8i and R9i, approximately 100 kg) or 600 mm (for frame sizes R11i and above, approximately 150 kg).

Type Marking	Width mm	Height mm	Weight kg
IGBT supply sections (380...415 V Range, U_N = 415 V)			
ACA 635-0265-3	1800 (400+400+400+600)	2130	650
ACA 635-0405-3	2000 (400+400+600+600)	2130	700
ACA 635-0500-3	2800 (600+400+600+1000)	2130	1100
ACA 635-0765-3	3200 (600+600+1000+1000)	2130	1250
ACA 635-1125-3	3700 (600+600+1000+1500)	2130	1850
ACA 635-1440-3	5200 (600+600+2x(1000+1000))	2130	2200
ACA 635-2145-3	6200 (600+600+2x(1000+1500))	2130	3350
ACA 635-2820-3	9600 (600+1000+4x(1000+1000))	2130	4100
IBGT supply sections (380...500 V Range, U_N = 500 V)			
ACA 635-0325-5	1800 (400+400+400+600)	2130	650
ACA 635-0495-5	2000 (400+400+600+600)	2130	700
ACA 635-0610-5	2800 (600+400+600+1000)	2130	1100
ACA 635-0935-5	3200 (600+600+1000+1000)	2130	1250
ACA 635-1385-5	3700 (600+600+1000+1500)	2130	1850
ACA 635-1760-5	5200 (600+600+2x(1000+1000))	2130	2200
ACA 635-2625-5	6200 (600+600+2x(1000+1500))	2130	3350
ACA 635-3450-5	9600 (600+1000+4x(1000+1000))	2130	4100
IGBT supply sections (525...690 V Range, U_N = 690 V)			
ACA 635-0315-6	1800 (400+400+400+600)	2130	650
ACA 635-0485-6	2000 (400+400+600+600)	2130	700
ACA 635-0600-6	2800 (600+400+600+1000)	2130	1100
ACA 635-0900-6	3200 (600+600+1000+1000)	2130	1250
ACA 635-1385-6	3700 (600+600+1000+1500)	2130	1850
ACA 635-1710-6	5200 (600+600+2x(1000+1000))	2130	2200
ACA 635-2545-6	6200 (600+600+2x(1000+1500))	2130	3350
ACA 635-3350-6	9200 (600+600+4x(1000+1000))	2130	4100
ACA 635-5140-6	11600 (600+1000+4x(1000+1500))	2130	6400

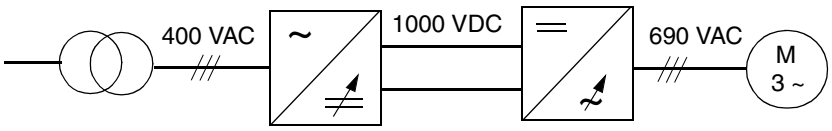
PDM code 00012716-A

Input Power Connection

Voltage (U_1):
380/400/415 VAC 3-phase for 415 VAC units
380/400/415/440/460/480/500 VAC 3-phase for 500 VAC units
525/550/575/600/660/690 VAC 3-phase for 690 VAC units

-40% *, +10% variation from converter nominal voltage is allowed.

* The ACA 635 can raise voltage with setting of Parameter 23.01 DC VOLT REF. Example: With 400 V supply voltage and 1000 VDC intermediate circuit voltage, it is possible to drive a 690 V motor with nominal motor voltage.



Short-circuit Capability (IEC 439)**:** The rated short-time withstand current of a drive equipped with an IGBT supply section is given below.

Frame Size	$I_{cw\,/\,1\,s}$ kA	I_{pk} kA
R8i	37	78
R9i	37	78
R10i	37	78
R11i ... 4 x R11i	50	105
R12i ... 4 x R12i	50	105

Frequency: 50 ± 2 Hz or 60 ± 2 Hz. Maximum rate of change 17%/s.

Unbalance: Max. ± 3 % of nominal phase to phase input voltage

Voltage Dips: Max. 15 %

Power Factor:
$\cos \varphi_1 = 1.00$ (fundamental at nominal load)

$\lambda = I_1/I_{rms} \cdot \cos \varphi_1 > 0.98$ (total) , where

λ is power factor,

I_1 is fundamental input current rms value,

I_{rms} is total input current rms value.

Harmonic Distortion

This table gives total harmonic distortion (THD) of the ACA 635.

THD Voltage %	**THD** Current %	R_{sc}
8	4	20
2	4	100

Definitions

Total Harmonic Distortion:

$$THD = \sqrt{\sum_{2}^{40}\left(\frac{I_n}{I_1}\right)^2}$$

I_n n^{th} harmonic component

I_1 fundamental current

THD is calculated as follows: ratio of the rms value of the harmonics (n = 2...40) to the rms value of the fundamental. The voltage THD depends on the short-circuit ratio. The spectrum of the distortion also contains interharmonics. See also *Applicable Standards*.

Ratio of the short-circuit power of the supply network (source) to the fundamental apparent power of the ACA 635 at point of common coupling:

$R_{sc} = S_{cc}/S_{equ}$, where

S_{cc} = short-circuit power at point of common coupling (PCC),

S_{equ} = apparent power of the equipment calculated with rated rms line current.

Switching Frequency

2 kHz (average).

Ambient Conditions

See *ACS 600 MultiDrive Safety and Product Information* (EN code: 63982229) guide or *ACx 6x7 Hardware Manual* (EN code: 61329005).

Efficiency

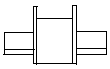
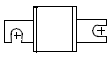
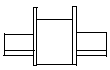
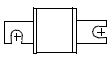
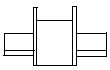
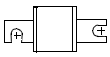
97 % at nominal power level

Fuses

The fuses (ultrarapid) of the IGBT supply section are given below. Only ultra rapid fuses guarantee proper protection for the rectifier semiconductors. Equivalent fuses from other manufacturers can also be used. U_N and I_N are nominal voltage and current of the fuse.

IGBT Supply Section AC Fuses

The a.c. fuses used in the ACA 635 IGBT supply sections are listed below.

IGBT Supply Type	Fuse				
	U_N (V)	I_N (A)	Type		Size
ACA 635-0265-3	660	630	170M6810	**DIN 43620**	3
ACA 635-0405-3	660	1000	170M6814		3
ACA 635-0500-3	1250	1250	170M6299		
ACA 635-0765-3	690	700	170M5874	**DIN 43653**	2
ACA 635-1125-3	690	900	170M5876		2
ACA 635-1440-3	690	700	170M5874		2
ACA 635-2145-3	690	900	170M5876		2
ACA 635-2820-3	690	700	170M5874		2
ACA 635-0325-5	660	630	170M6810	**DIN 43620**	3
ACA 635-0495-5	660	1000	170M6814		3
ACA 635-0610-5	1250	1250	170M6299		
ACA 635-0935-5	690	700	170M5874	**DIN 43653**	2
ACA 635-1385-5	690	900	170M5876		2
ACA 635-1760-5	690	700	170M5874		2
ACA 635-2625-5	690	900	170M5876		2
ACA 635-3450-5	690	700	170M5874		2
ACA 635-0315-6	1250	400	170M6303	**DIN 43620**	3SHT
ACA 635-0485-6	1250	630	170M6205		3SHT
ACA 635-0600-6	1250	800	170M6203		
ACA 635-0900-6	690	900	170M5876	**DIN 43653**	2
ACA 635-1385-6	690	700	170M5874		2
ACA 635-1710-6	690	900	170M5876		2
ACA 635-2545-6	690	700	170M5874		2
ACA 635-3350-6	690	900	170M5876		2
ACA 635-5140-6	690	700	170M5874		2

IGBT Supply Unit DC Fuses

The d.c. fuses (Bussmann) used in the IGBT supply units are listed below.

IGBT Supply Section Frame Type	U_N [V]	Size	I_N [A]	Type	IGBT Supply Section Frame Type	U_N [V]	Size	I_N [A]	Type
415 V and 500 V Range					690 V Range				
R8i, R10i	660V	3	630	170M6810	R8i, R10i	1250V	3SHT	400	170M6303
R9i R11i 2xR11 4xR11i R12i 2xR12i	660V	3	1000	170M6814	R9i R11i 4xR11i R12i 2xR12i 4xR12i	1250V	3SHT	630	170M6205

PDM code 00018306

Power Cable Entries

Notes concerning the cable entry table are below.

Tightening Torque

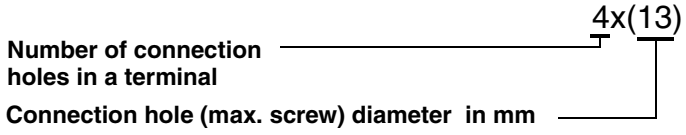
The tightening torques for screw connections, applicable to zinc and chrome platings and screw strength class 8.8 are presented below.

Screw	Torque (Nm) *	
	Soft aluminium	Alloyed aluminium and copper
M5	3.5	3.5
M6	6	9
M8	17	20
M10	35	40
M12	55	70
M16	130	180

* valid also for greased screws

Marking

Below is explained how cable connections are marked in the following table. The terminals accept cable lugs according to DIN 46234 for copper cables and DIN 46329 for aluminium cables.



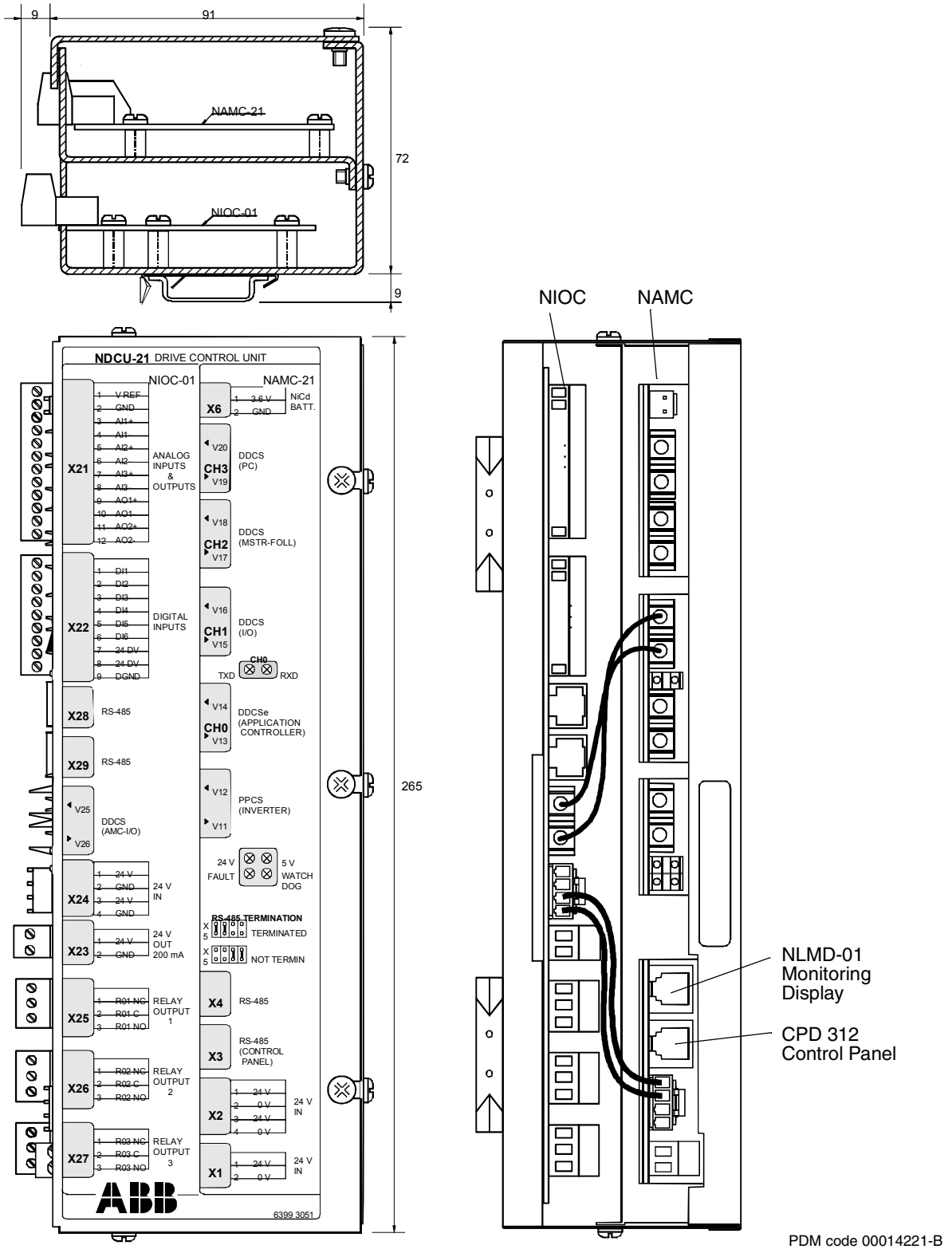
Note: Cable lugs can also be fastened using screws one size down from the hole size. Example: A cable lug with a hole diameter of 12.5 mm can be fastened with either a M12 or a M10 bolt.

IGBT Supply Sections The connection holes for cable lugs are presented below.

Type	Holes for cable lugs per phase	Number of cable entries at bottom (diameter 60 mm)	Bottom plate opening dimensions (mm)	Number of cable entries at top (diameter 60 mm)
380V, 400V, 415V				
ACA 635-0265-3	4x(∅14)	6	270x511	6
ACA 635-0405-3	4x(∅14)	6	270x511	6
ACA 635-0500-3	4x(∅14)	6	270x511	6
ACA 635-0765-3	6x(13x18)	6	270x911	6
ACA 635-1125-3	8x(13x18)	12	195x501	12
ACA 635-1440-3	16x(13x18)	18	270x711	18
ACA 635-2145-3	16x(13x18)	18	270x711	18
ACA 635-2820-3	16x(13x18)	18	270x711	18
440V, 460V, 500V				
ACA 635-0325-5	4x(∅14)	6	270x511	6
ACA 635-0495-5	4x(∅14)	6	270x511	6
ACA 635-0610-5	4x(∅14)	6	270x511	6
ACA 635-0935-5	6x(13x18)	6	270x911	6
ACA 635-1385-5	8x(13x18)	6	270x911	6
ACA 635-1760-5	16x(13x18)	12	195x501	12
ACA 635-2625-5	16x(13x18)	18	270x711	18
ACA 635-3450-5	16x(13x18)	18	270x711	18
575V, 660V, 690V				
ACA 635-0315-6	4x(∅14)	6	270x511	6
ACA 635-0485-6	4x(∅14)	6	270x511	6
ACA 635-0600-6	4x(∅14)	6	270x511	6
ACA 635-0900-6	6x(13x18)	6	270x911	6
ACA 635-1385-6	8x(13x18)	12	195x501	12
ACA 635-1710-6	8x(13x18)	12	195x501	12
ACA 635-2545-6	16x(13x18)	18	270x711	18
ACA 635-3350-6	16x(13x18)	18	270x711	18
ACA 635-5140-6	32x(13x18)	18	270x911	18

Drive Control Unit NDCU-2x

This figure shows the NDCU-21 containing an NAMC-21 board and an NIOC-01 board. The NDCU-22 with an NAMC-22 board and an NIOC-01 board looks similar.



PDM code 00014221-B

NIOC Board Connections

External control connections for the IGBT Supply Unit on the NIOC board are shown below.

Terminal Block Size
X21, X22: cables 0.5 to 1.5 mm^2
X23, X25, X26, X27: cables 0.5 to 2.5 mm^2

NIOC Board — **Factory Settings**

X21 — **Programmable**

1	VREF	Reference voltage 10 V d.c.
2	GND	1 kΩ ≤ R_L ≤ 10 kΩ
3	AI1+	By default, not in use. 0(2) ... 10 V
4	AI1-	R_{in} > 200 kΩ
5	AI2+	By default, not in use.
6	AI2-	0(4) ... 20 mA, R_{in} = 100 Ω
7	AI3+	By default, not in use.
8	AI3-	0(4) ... 20 mA, R_{in} = 100 Ω
9	AO1+	By default, not in use.
10	AO1-	0(4) ... 20 mA, R_{in} = 100 Ω
11	AO2+	By default, not in use.
12	AO2-	0(4) ... 20 mA, R_{in} = 100 Ω

X22 — **Fixed**

1	DI1	Acknowledgement of converter fan
2	DI2	Stop/Start
3	DI3	Acknowledgement of main contactor
4	DI4	Earth fault
5	DI5	–
6	DI6	Reset
7	+24V	+24 V d.c. max. 100 mA
8	+24V	
9	DGND	Digital Ground

X23 — **Fixed**

1	+24 V	Auxiliary voltage output, non-isolated,
2	GND	24 V d.c. 250 mA

X25 — **Fixed**

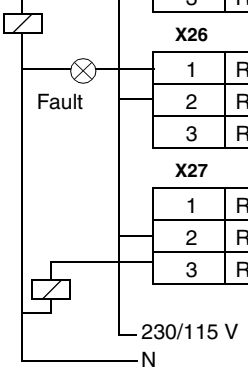
1	RO11	Relay output 1
2	RO12	Charging contactor control
3	RO13	

X26 — **Fixed**

1	RO21	Relay output 2
2	RO22	Fault (-1)
3	RO23	

X27 — **Fixed**

1	RO31	Relay output 3
2	RO32	Main contactor control
3	RO33	



RS 485 serial line connector X28 *

1	TRANS	Not in use with the NAMC-21/ 22
2	GND	
3	B-	
4	A+	
5	GND	
6	+24V	

RS 485 serial line connector X28 *

1	TRANS	Not in use with the NAMC-21/ 22
2	FAULT	
3	B-	
4	A+	
5	GND	
6	+24V	

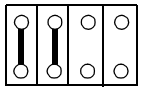
* Connector shield is connected via RC filter to frame.

Control Panel

The Control Panel (CDP 312) is connected to 6-pin modular connector X3 on the NAMC-21/22 board. The modular connectors on the NIOC board are **not** intended for the Control Panel.

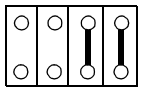
RS-485 Termination Settings

When the Control Panel CDP 312 is connected to one NAMC-21/22 board only, the RS-485 line must be terminated on the NAMC-21/22 board by jumpers X5 as follows:



Terminated

If the CDP 312 is connected to several NAMC 21/22 boards (RS-485 panel bus), the first and the last NAMC 21/22 board must be terminated and the intermediate boards not terminated.



Not terminated

NLMD-01 Monitoring Display

The NLMD-01 monitoring display is connected to 6-pin modular connector X4 on the NAMC-21/22 board. The modular connectors on the NIOC board are **not** intended for the monitoring display.

NIOC Board Specifications

This table gives data for the external control connection board NIOC-01 of the IGBT supply section. For external control connections of the control section refer to Common Drive Control Manuals.

	IGBT Supply Section NIOC-01 Board
Constant Voltage Output	**Voltage:** 10 VDC ± 0.5 % (Full-scale Range) at 25 °C. Temperature Coefficient: ± 100 ppm/°C, max. **Maximum Load:** 10 mA **Applicable Potentiometer:** 1 kΩ to 10 kΩ
Auxiliary Power Output	**Voltage:** 24 VDC ± 10 %, Short-circuit proof **Maximum Current:** 250 mA or 130 mA with NLMD-01 option
Analogue Outputs	**Two Programmable Current Outputs:** 0 (4) to 20 mA, $R_L \leq 700\ \Omega$ **Resolution:** 0.1 % (10 bit) **Inaccuracy:** ± 1 % (Full-scale Range) at 25 °C. Temperature Coefficient: ± 200 ppm/°C, max. **Output Updating Time:** 4 ms
Digital Inputs	**Six Digital Inputs (Common Ground):** 24 VDC, -15 to +20 % **Logical Thresholds:** < 8 VDC ≙ "0", > 12 VDC ≙ "1" **Input Current:** DI1 to DI 5: 10 mA, DI6: 5 mA **Filtering Time Constant:** 1 ms **Internal Supply For Digital Inputs (+24 VDC):** Short-circuit proof, group isolated **Isolation Test Voltage:** 500 VAC, 1 minute **Input Updating Time:** 10 ms An external 24 VDC supply can be used instead of the internal supply.

	IGBT Supply Section NIOC-01 Board
Relay Outputs	**Three Relay Outputs** **Switching Capacity:** 8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC **Maximum Continuous Current:** 2 A rms **Contact Material:** Silver Cadmium Oxide (AgCdO) **Isolation Test Voltage:** 4 kVAC, 1 minute **Output Updating Time:** 100 ms
DDCS Fibre Optic Link	**Protocol:** DDCS (ABB Distributed Drives Communication System)

Applicable Standards

The ACA 635 complies with the following standards:

- EN 60204-1: 1992 + Corr. 1993 (IEC 204-1). Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- EN 60529: 1991 (IEC 529), IEC 664-1: 1992. Degrees of protection provided by enclosures (IP code). EN 50178: 1986. Electronic equipment for use in power installations.
- EN 61800-3 (1996): EMC product standard including specific test methods.
- IEC 1000-3-4 TR2 Stage 3. Limitation of emission of harmonic currents in low voltage power supply sytems with rated currrent greater than 16 A. (for line current)
- IEC 1000-2-4 Class 3. Compatibility levels in industrial plants for low-frequency conducted disturbances. (for line voltage)
- IEEE 519: 1992. Recommended practicies and requirements for harmonic control in electrical power systems. Total demand distortion (TDD).

CE Marking

A CE mark is attached to ACS 600 MultiDrive frequency converters (380...690 V ranges) to verify that the unit fulfils the European Low Voltage and EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

Compliance with the EMC Directive

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used in the European Economic Area. The EMC product standard EN 61800-3 covers the requirements stated for frequency converters.

The ACS 600 MultiDrive frequency converters comply with the EMC Directive in industrial low-voltage network, and IT networks (unearthed mains) with the following provisions.

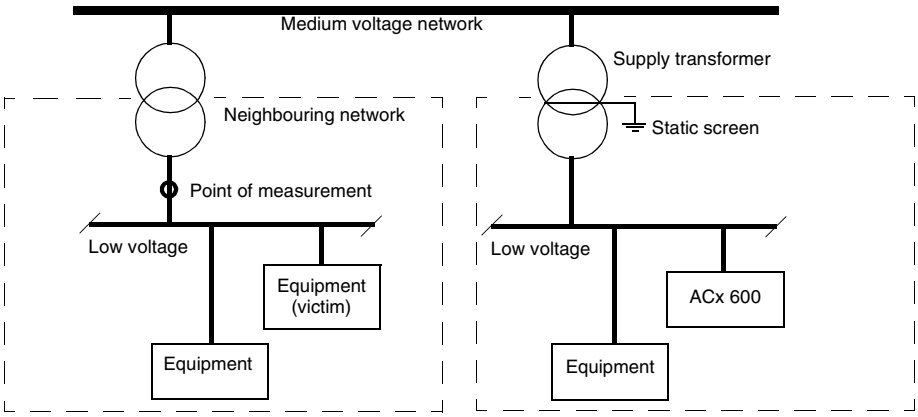
Industrial Low-Voltage Network

1. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.
2. The ACS 600 MultiDrive is installed according to the instructions given in the *Hardware Manual* (EN code 63700118).
3. The motor and control cables are selected as specified in the *Hardware Manual* (EN code 63700118).

Note: The ACA 635 must not be equipped with the EMC filtering.

*Table A-1 The EMC filtering of the ACx 600 units is marked in the type code as follows. * du/dt Filters + EMC Filters, ** du/dt Filters + No EMC Filters, *** EMC Cabinet with EMC Filters.*

ACS 600 Type	**Type Code**		
	Character no.	EMC Filter Selections	No EMC Filter Selections
ACS 600 MultiDrive Supply Section	ACA63xxxxxxxxxxxxx... ↑ 16	1, 2***	0
Drive Section	ACA610xxxxxxxxxxxx... ↑ 16	1	0



Use of the ACx 600 in Second Environment without EMC filtering (EN 61800-3: second environment includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.)

Unearthed Mains (IT Network)

1. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.
2. The ACS 600 MultiDrive is installed according to the instructions given in the *Hardware Manual* (EN code 63700118).
3. The motor and control cables are selected as specified in the *Hardware Manual* (EN code 63700118).
4. ***Note:*** The ACS 600 MultiDrive must not be equipped with EMC filtering when installed to floating networks. The mains becomes connected to earth potential through the EMC filter capacitors. In floating networks this may cause danger or damage the unit.

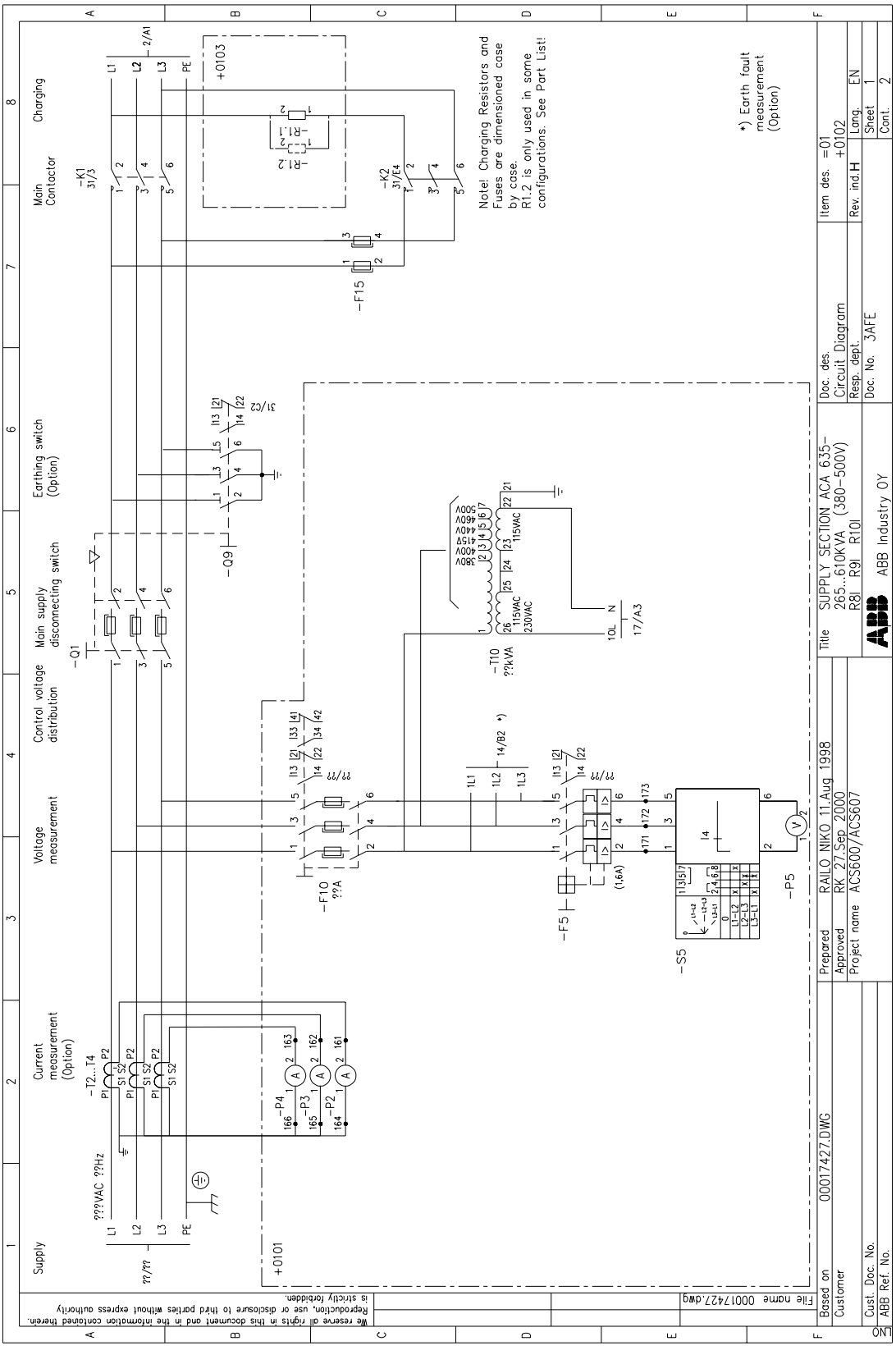
Machinery Directive

ACS 600 MultiDrive frequency converters comply with the European Union Machinery Directive (89/392/EEC) requirements for an equipment intended to be incorporated into machinery.

Appendix B – Circuit Diagrams

Overview

The following pages contain some circuit diagrams of supply sections equipped with an IGBT supply unit for helping to understand the configuration of the supply section. The diagrams do not necessarily match with each delivery. The wiring varies depending on the power rating and the selected equipment. The circuit diagrams valid for each supply section are included in the delivery.


Supply
Current measurement (Option)
Voltage measurement
Control voltage distribution
Main supply disconnecting switch
Earthing switch (Option)
Main Contactor
Charging
Note! Charging Resistors and Fuses are dimensioned case by case. R1.2 is only used in some configurations. See Part List!
*) Earth fault measurement (Option)
Title SUPPLY SECTION ACA 635- 265...610KVA (380-500V) R8i R9i R10i
Doc. des. Circuit Diagram
Resp. dept.:
Doc. No. 3AFE
Item des. =01 +0102
Rev. ind. H
Lang. EN
Sheet 1
Cont. 2
ABB Industry OY
Prepared RAILO NIKO 11.Aug 1998
Approved RK 27.Sep 2000
Project name ACS600/ACS607
Based on 00017427.DWG
Customer
Cust. Doc. No.
ABB Ref. No.
File name 00017427.dwg
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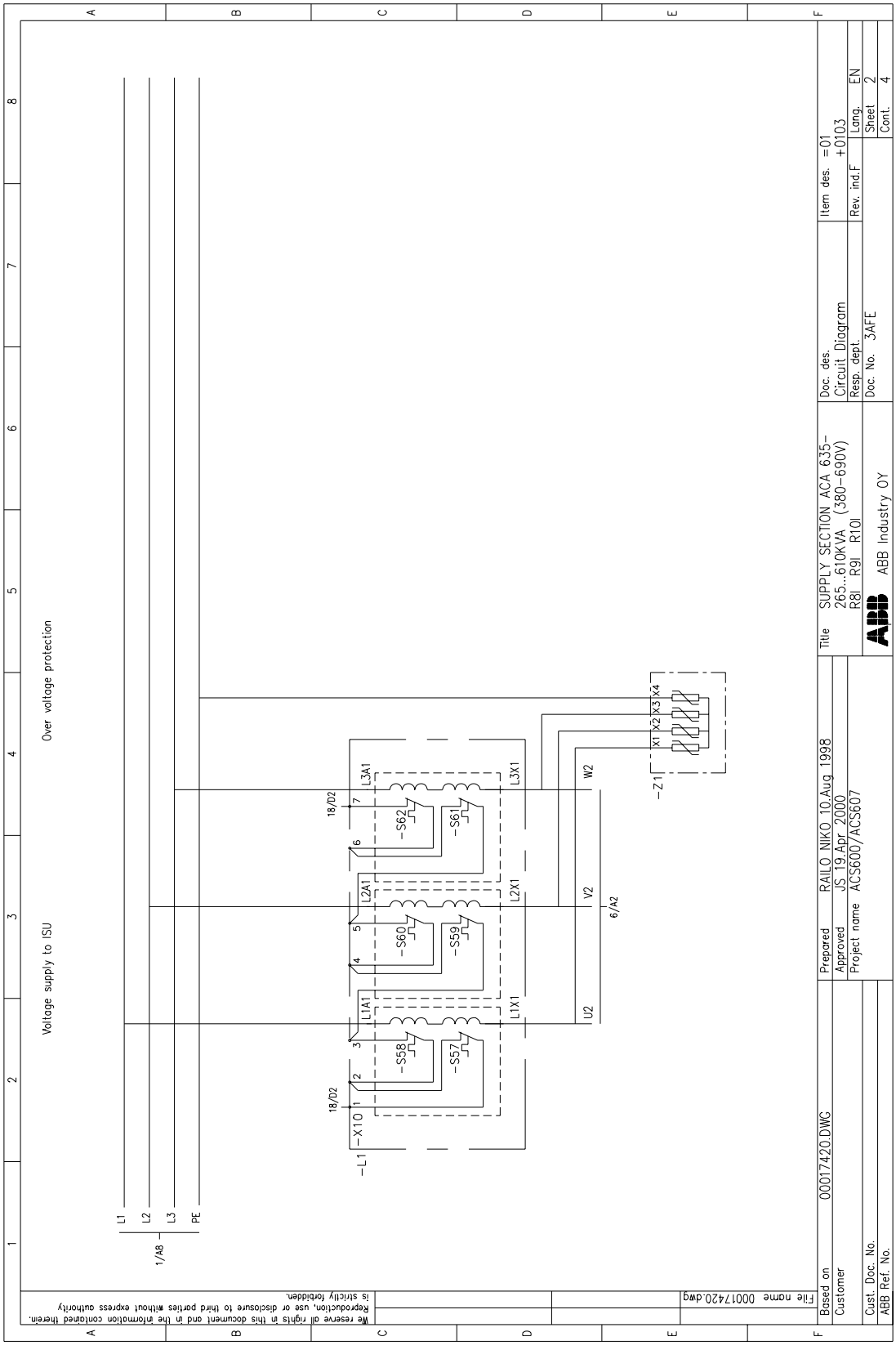
Voltage supply to ISU
Over voltage protection
L1
L2
L3
PE
1/A8
-L1
-X10
-S58
-S57
-S60
-S59
-S62
-S61
-Z1
L1A1
L2A1
L3A1
L1X1
L2X1
L3X1
U2
V2
W2
6/A2
18/02
18/02
Prepared RAILO NIKO 10.Aug 1998
Approved JS 19.Apr 2000
Project name ACS600/ACS607
Title SUPPLY SECTION ACA 635-265...610KVA (380-690V) R8I R9I R10I
ABB Industry OY
Doc. des. Circuit Diagram
Doc. No. 3AFE
Item des. =01 +0103
Rev. ind.F
Lang. EN
Sheet 2
Cont. 4
Based on 00017420.DWG
Customer
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File name 00017420.dwg
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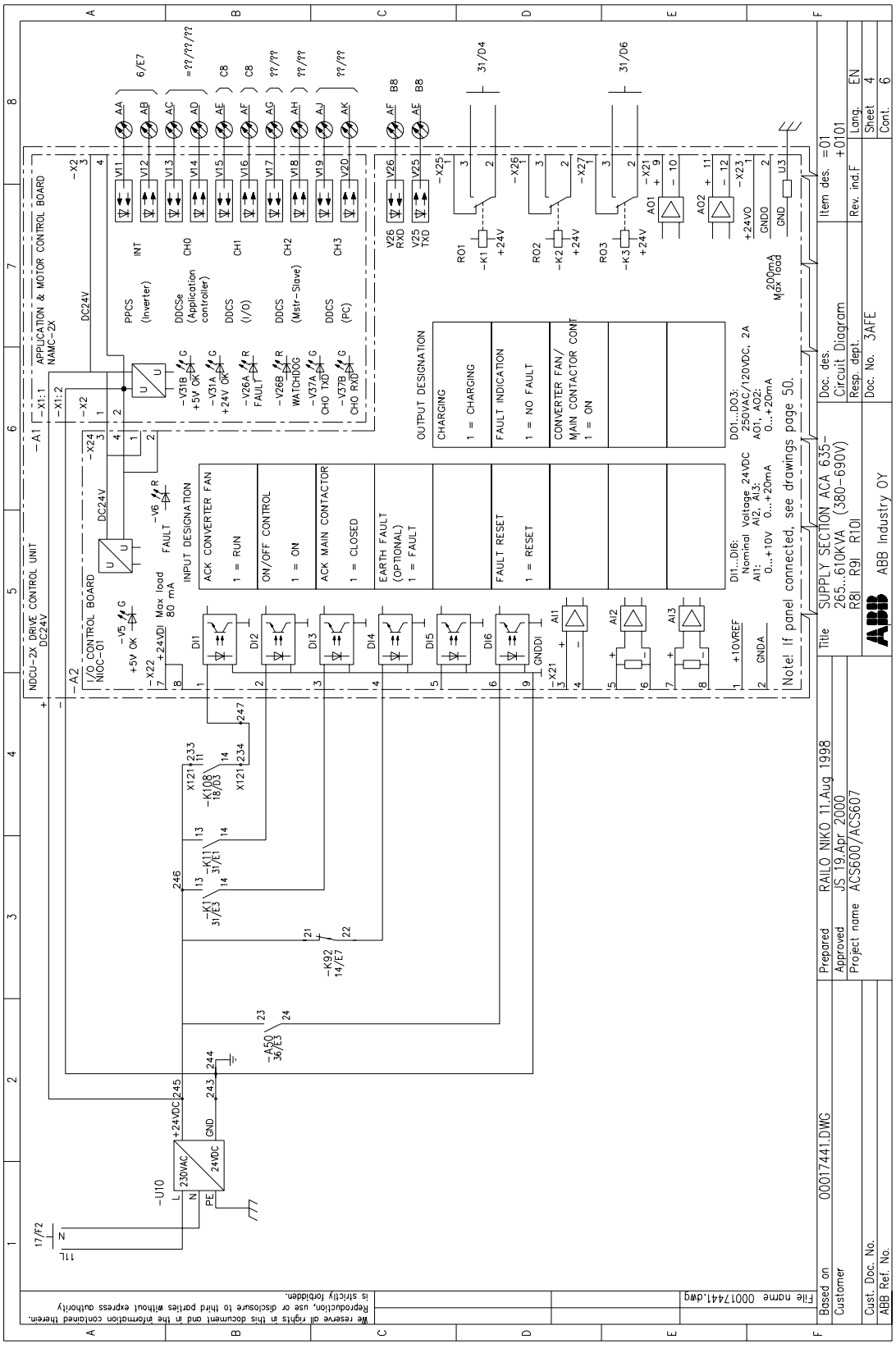
NDCU-2X DRIVE CONTROL UNIT
DC24V
APPLICATION & MOTOR CONTROL BOARD
NAMC-2X
I/O CONTROL BOARD
NIOC-01
Max load 80 mA
INPUT DESIGNATION
ACK CONVERTER FAN
1 = RUN
ON/OFF CONTROL
1 = ON
ACK MAIN CONTACTOR
1 = CLOSED
EARTH FAULT (OPTIONAL)
1 = FAULT
FAULT RESET
1 = RESET
OUTPUT DESIGNATION
CHARGING
1 = CHARGING
FAULT INDICATION
1 = NO FAULT
CONVERTER FAN/ MAIN CONTACTOR CONT
1 = ON
PPCS (Inverter)
DDCSe (Application controller)
DDCS (I/O)
DDCS (Mstr-Slave)
DDCS (PC)
INT
CH0
CH1
CH2
CH3
Note: If panel connected, see drawings page 50.
Title
SUPPLY SECTION ACA 635-
265...610KVA (380-690V)
R8I R9I R10I
ABB Industry OY
Doc. des.
Circuit Diagram
Item des. =01
+0101
Doc. No. 3AFE
Prepared RAILO NIKO 11.Aug 1998
Approved JS 19.Apr 2000
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Based on 00017441.DWG
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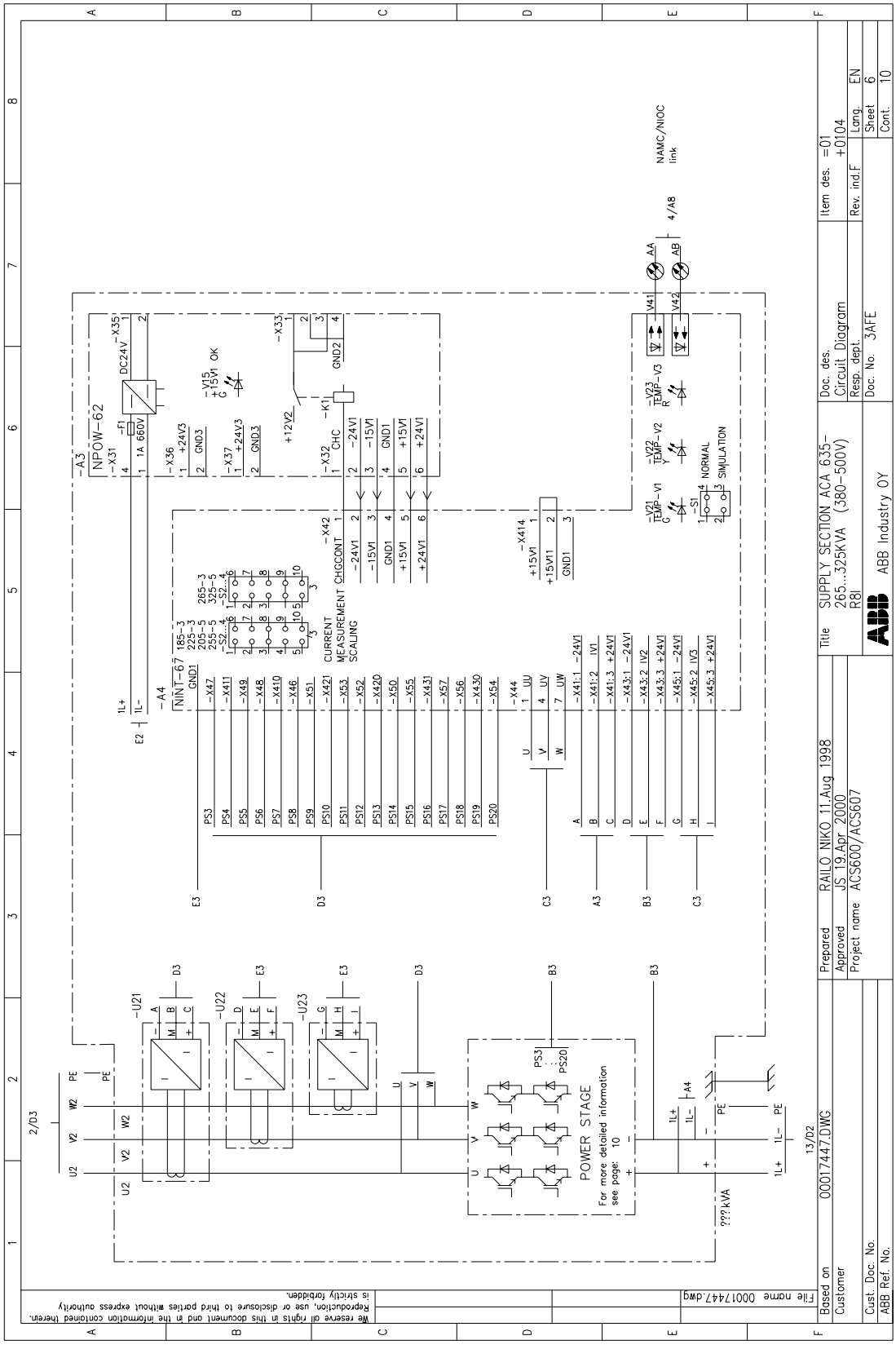
-A3
NPOW-62
-A4
NINT-67
POWER STAGE
SUPPLY SECTION ACA 635-
265...325KVA (380-500V)
R8i
ABB Industry OY
Doc. No. 3AFE
Item des. =01
+0104
Rev. ind.F
Lang. EN
Sheet 6
Cont. 10
Prepared RAILO NIKO 11.Aug 1998
Approved JS 19.Apr 2000
Project name ACS600/ACS607
Based on 00017447.DWG
Customer
Cust. Doc. No.
ABB Ref. No.
File name 00017447.dwg
CURRENT MEASUREMENT SCALING
CHGCONT
CHC
NORMAL
SIMULATION
NAMC/NIOC link
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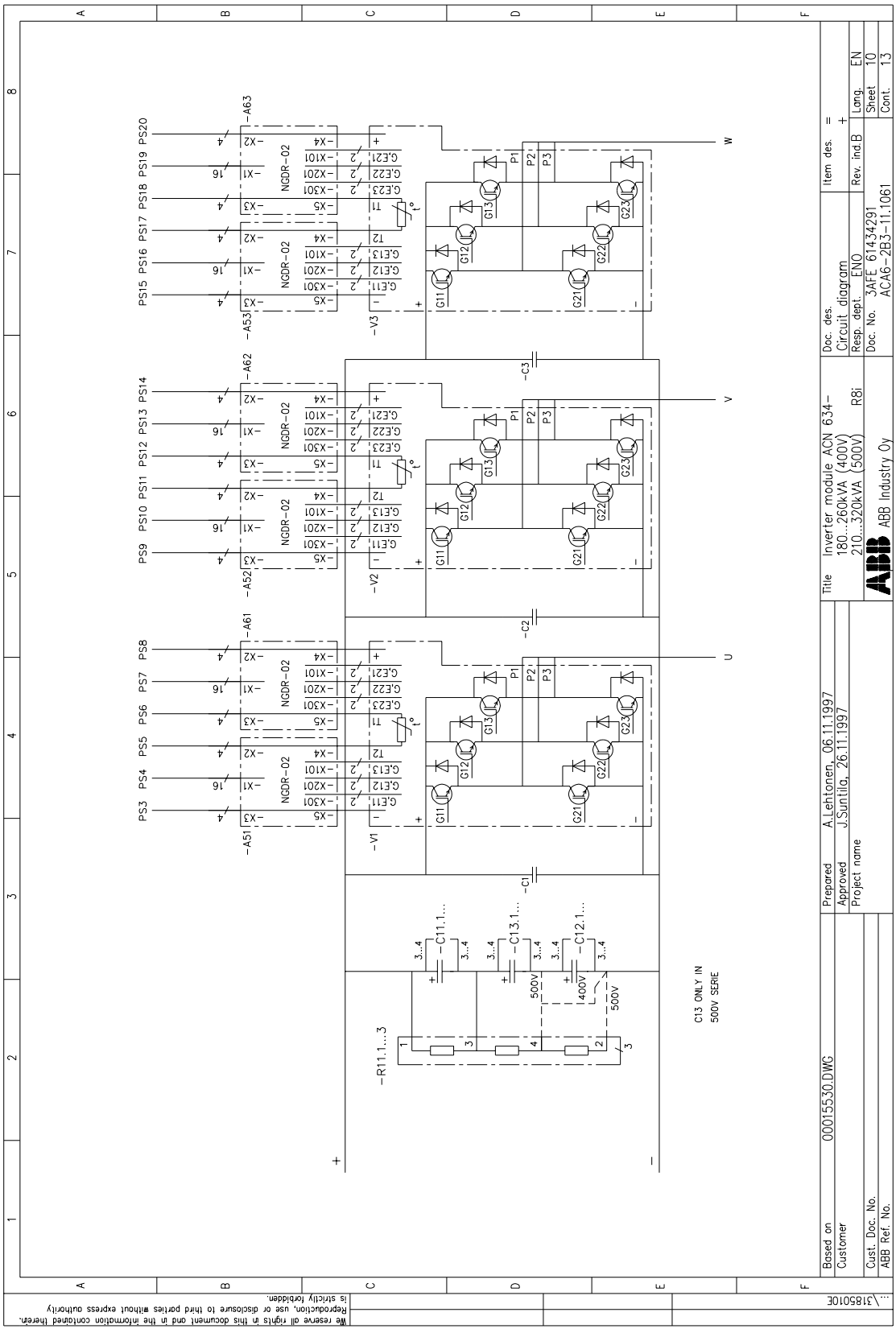
Inverter module ACN 634-
180...260kVA (400V)
210...320kVA (500V)
R8i
ABB Industry Oy
3AFE 61434291
ACA6-2B3-11.1061
Circuit diagram
Prepared A.Lehtonen 06.11.1997
Approved J.Suntila 26.11.1997
Project name
0001553O.DWG
C13 ONLY IN
500V SERIE
-R11.1...3
-C11.1...
-C13.1...
-C12.1...
-V1
-V2
-V3
-C1
-C2
-C3
-A51
-A52
-A53
-A61
-A62
-A63
NGDR-02
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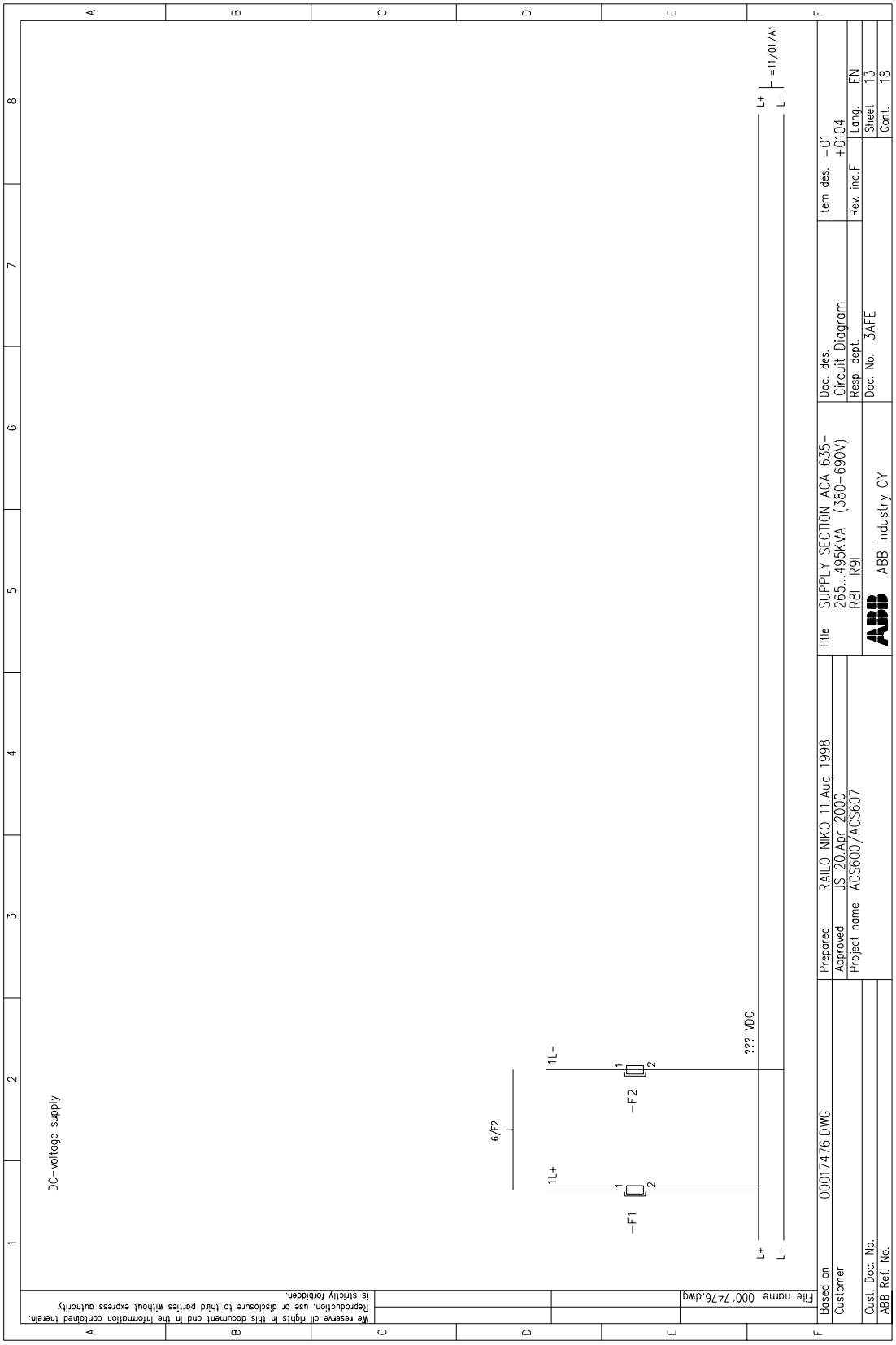
DC-voltage supply
6/F2
1L+
1L-
-F1
-F2
??? VDC
L+
L-
=11/01/A1
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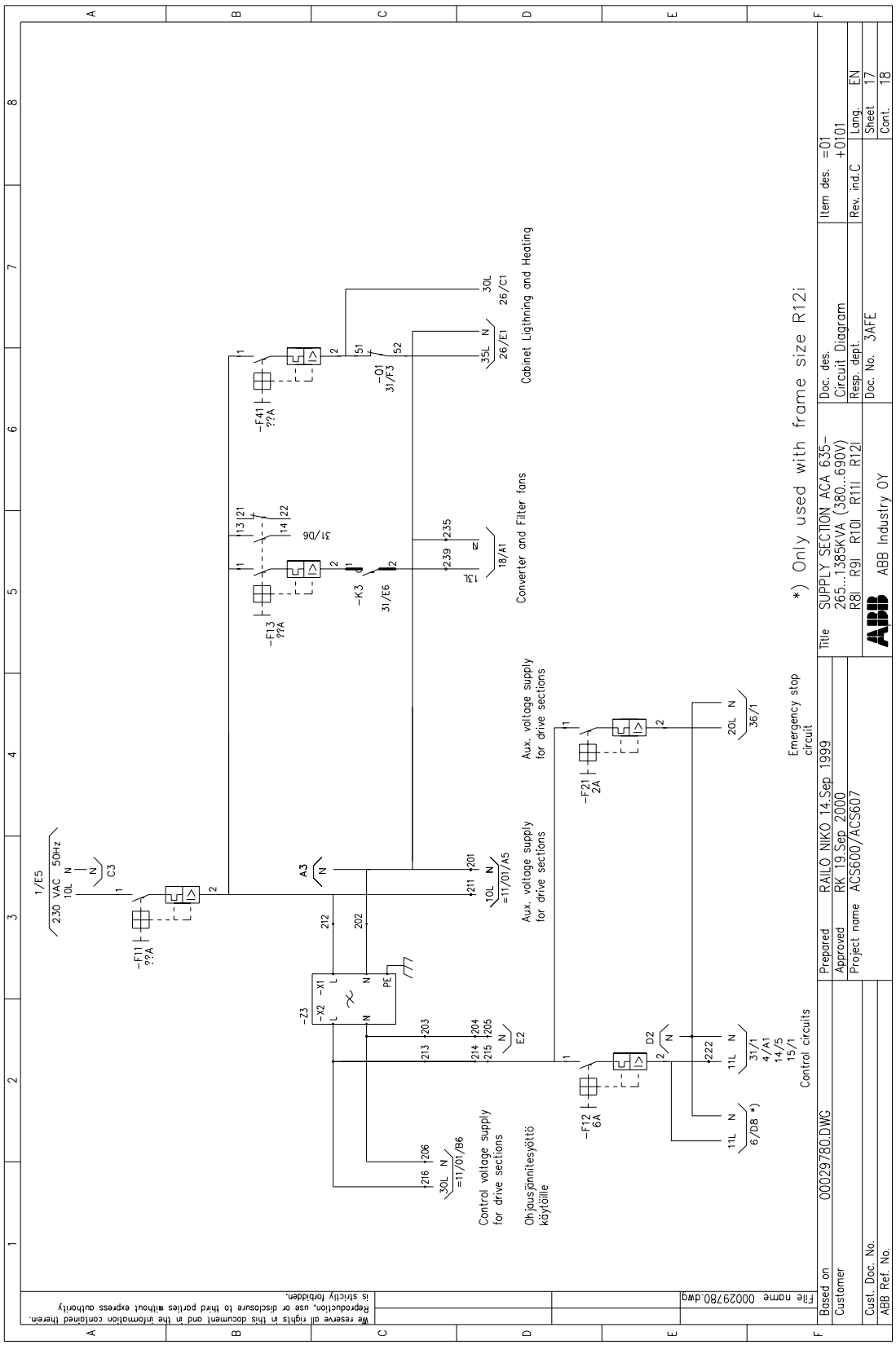
File name 0001747G.dwg
Based on 0001747G.DWG
Customer
Cust. Doc. No.
ABB Ref. No.
Prepared RAILO NIKO 11.Aug.1998
Approved JS 20.Apr 2000
Project name ACS600/ACS607
Title SUPPLY SECTION ACA 635-
265...495KVA (380-690V)
R8I R9I
ABB Industry OY
Doc. des. Circuit Diagram
Resp. dept.
Doc. No. 3AFE
Item des. =01
+0104
Rev. ind.F
Lang. EN
Sheet 13
Cont. 18


*) Only used with frame size R12i
Title SUPPLY SECTION ACA 635-
265...1385KVA (380...690V)
R8I R9I R10I R11I R12I
ABB Industry OY
Doc. des. Circuit Diagram
Item des. =01 +0101
Rev. ind.C
Lang. EN
Sheet 17
Cont. 18
Prepared RAILO NIKO 14.Sep 1999
Approved RK 19.Sep 2000
Project name ACS600/ACS607
Based on 00029780.DWG
Customer
Cust. Doc. No.
ABB Ref. No.
File name 00029780.dwg
Cabinet Lighting and Heating
Converter and Filter fans
Aux. voltage supply for drive sections
Aux. voltage supply for drive sections
Emergency stop circuit
Control circuits
Control voltage supply for drive sections
Ohjausjännitesyöttö käytöille
-F11 ??A
-F13 ??A
-F41 ??A
-F21 2A
-F12 6A
-Q1 31/F3
-K3 31/E6
-Z3
-X1
-X2
1/E5
230 VAC 50Hz
10L N
C3
31/D6
18/A1
30L 26/C1
35L N 26/E1
10L N =11/01/A5
20L N 36/1
11L N 31/1 4/A1 14/5 15/1
11L N 6/D8 *)
30L N =11/01/B6
E2
D2
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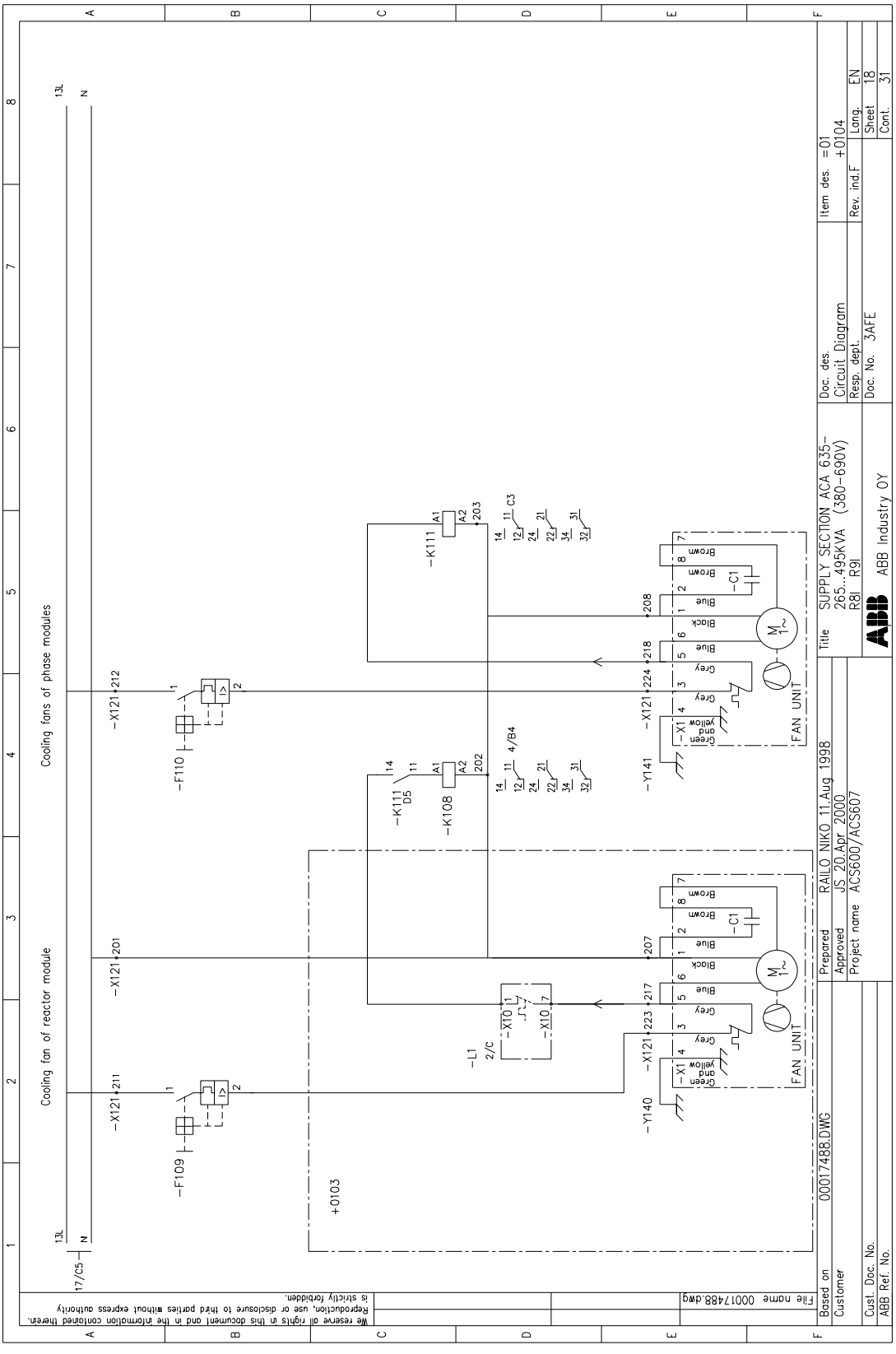
Cooling fans of phase modules
Cooling fan of reactor module
+0103
-F109
-F110
-K108
-K111
-K111
-L1
-X10
-X10
-X121
-X121
-X121
-X121
-X121
-X121
-Y140
-Y141
FAN UNIT
FAN UNIT
-C1
-C1
M 1~
M 1~
Blue
Black
Grey
Green and yellow
Brown
Brown
Blue
Black
Grey
Green and yellow
Brown
Brown
Item des. =01 +0104
Doc. des. Circuit Diagram
Resp. dept. R8I R9I
Rev. ind.F
Doc. No. 3AFE
Long. EN
Sheet 18
Cont. 31
Title SUPPLY SECTION ACA 635-265..495KVA (380-690V)
ABB Industry OY
Prepared RAILO NIKO 11.Aug 1998
Approved JS 20.Apr 2000
Project name ACS600/ACS607
File name 00017488.DWG
Based on 00017488.DWG
Customer
Cust. Doc. No.
ABB Ref. No.
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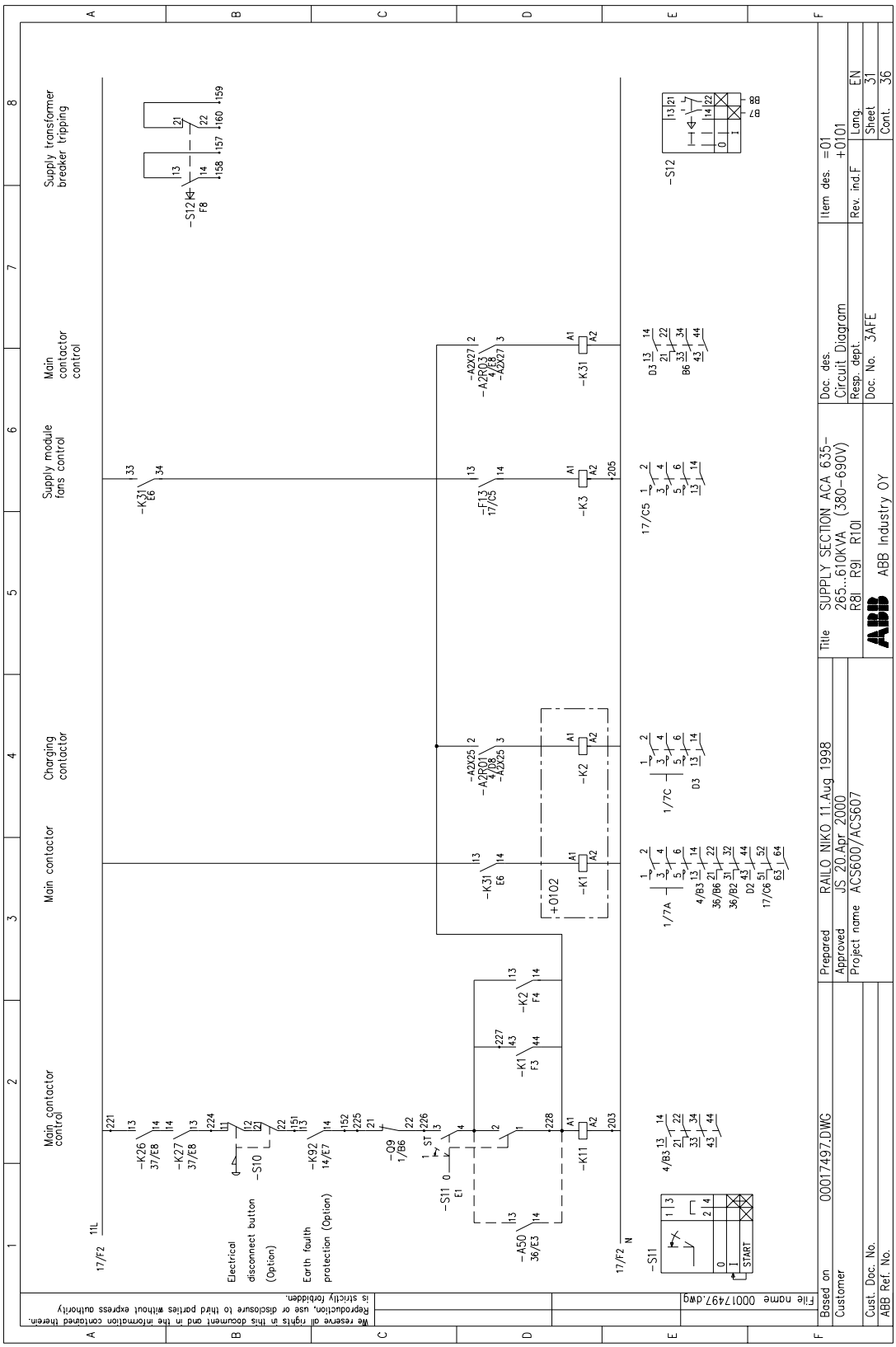
Supply transformer breaker tripping
Main contactor control
Supply module fans control
Main contactor control
Charging contactor
Main contactor
Main contactor control
Electrical disconnect button (Option)
Earth fault protection (Option)
-K31 E6
-K3
-K2
-K1
-K11
-K26 37/E8
-K27 37/E8
-K92 14/E7
-S10
-S11 E1
-S12 F8
-K2 F4
-K1 F3
-A50 36/E3
-09 1/B6
+0102
-A2X27
-A2R03 4/B8
-A2X25
-A2R01 4/B8
-F13 17/C5
-S12
-S11
START
17/F2
17/C5
1/7C
1/7A
4/B3
36/B6
36/B2
D2
17/C6
D3
B6
B7
B8
Prepared RAILO NIKO 11.Aug 1998
Approved JS 20.Apr 2000
Project name ACS600/ACS607
Based on 00017497.DWG
Customer
Cust. Doc. No.
ABB Ref. No.
File name 00017497.dwg
Title SUPPLY SECTION ACA 635-265...610KVA (380-690V) R8I R9I R10I
ABB Industry OY
Doc. des. Circuit Diagram
Resp. dept.
Doc. No. 3AFE
Item des. =01 +0101
Rev. ind.F
Lang. EN
Sheet 31
Cont. 36
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